

PUBLIC VERSION

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MONOLITHIC POWER SYSTEMS, INC.,
Petitioner,

v.

GREENTHREAD, LLC,
Patent Owner.

IPR2024-00550
Patent 10,510,842 B2

Before KRISTEN L. DROESCH, GRACE KARAFFA OBERMANN, and
DONNA M. PRAISS, *Administrative Patent Judges*.

OBERMANN, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)
Dismissing Patent Owner's Motion to Exclude
37 C.F.R. § 42.64(c)

I. INTRODUCTION

A. *Background and Summary*

Monolithic Power Systems, Inc. (“Petitioner” or “MPS”) filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 1, 2, 4–9, and 12–18 (“the challenged claims”) of U.S. Patent No. 10,510,842 B2 (Ex. 1001, “the ’842 patent”), accompanied by the supporting Declaration of Stephen Campbell, Ph.D. (Ex. 1003). Greenthread, LLC (“Patent Owner”) filed a Preliminary Response. Paper 11 (“Prelim. Resp.”).

With our authorization, Petitioner filed a Preliminary Reply (Paper 17, “Prelim. Reply”) and Patent Owner filed a Preliminary Sur-reply (Paper 18).

Upon review of the preliminary record, we instituted *inter partes* review, pursuant to 35 U.S.C. § 314, as to the challenged claims based on the challenges set forth in the Petition. Paper 20 (“Institution Decision” or “Inst. Dec.”). Patent Owner filed a Response (Paper 32, “Patent Owner’s Response” or “PO Resp.”), Petitioner filed a Reply to Patent Owner’s Response (Paper 36, “Petitioner’s Reply” or “Pet. Reply”), and Patent Owner filed a Sur-Reply (Paper 45, “Patent Owner’s Sur-Reply” or “PO Sur-Reply”).

Patent Owner filed a motion to exclude evidence. Paper 52 (“Motion to Exclude” or “Mot. Exclude”). Petitioner filed an opposition to the motion (Paper 53), to which Patent Owner filed a reply (Paper 57).

On September 10, 2025, we held an oral hearing. A transcript of the hearing is of record. Paper 77 (“Tr.”).

For the reasons that follow, we conclude that Petitioner has established, by a preponderance of the evidence, that challenged claims 1, 2,

4–9, and 12–18 of the ’842 patent are unpatentable. We also dismiss as moot Patent Owner’s Motion to Exclude.

B. Real Parties-in-Interest

Petitioner identifies Monolithic Power Systems, Inc. as the real party in interest. Pet. 1. Patent Owner identifies Greenthread, LLC as the real party-in-interest. Paper 4, 1.

C. Related Matters

The parties indicate that the ’842 patent is involved in the following district court cases: *Greenthread, LLC v. Cirrus Logic, Inc.*, No. 1:23-cv-00369 (W.D. Tex.); *Greenthread, LLC v. OmniVision Technologies, Inc.*, No. 2:23-cv-00212 (E.D. Tex.); *Greenthread, LLC v. OSRAM GmbH et al.*, No. 2:23-cv-00179 (E.D. Tex.); *Greenthread, LLC v. ON Semiconductor Corp.*, No. 1:23-cv-00443 (D. Del.); *Greenthread, LLC v Texas Instruments Incorporated*, No. 2:23-cv-00157 (E.D. Tex.); and *Greenthread, LLC v. Monolithic Power Systems, Inc.*, No. 1:23-cv-00579 (D. Del.). Pet. 1–2; Paper 4, 1–2.

D. The ’842 Patent

The ’842 patent issued December 17, 2019, and claims the benefit of a series of continuation applications, the earliest of which was filed September 3, 2004. Ex. 1001, codes (45), (60). The ’842 patent is titled “Semiconductor Devices with Graded Dopant Regions” and “relates to all semiconductor devices and systems.” *Id.* at code (54), 1:32–33.

The ’842 patent explains that, in bipolar junction transistors, minority carriers are the principal device conduction mechanism, but notes that majority carriers also play a small but finite role in modulating the conductivity in such devices. Ex. 1001, 1:43–47. The ’842 patent further

explains that “[e]fforts have been made in graded base transistors to create an aiding drift field to enhance the diffusing minority carrier’s speed from emitter to collector.” *Id.* at 1:55–57. According to the ’842 patent, this improvement has not been implemented in most semiconductor devices, including various power MOSFETs and IGBTs, which “still use a uniformly doped ‘drift epitaxial’ region in the base.” *Id.* at 1:57–62. The invention of the ’842 patent implements a graded dopant concentration in these devices, which the ’842 patent contends results in two important performance enhancements: “electrons can be swept from source to drain rapidly, while at the same time holes can be recombined closer to the n⁺ buffer layer,” thereby improving “ t_{on} and t_{off} in the same device.” *Id.* at 3:40–43.

Figure 1 of the ’842 patent is reproduced below.

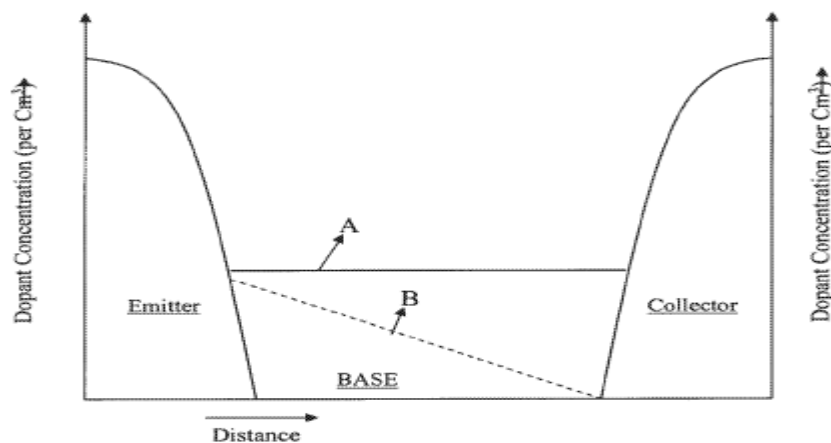


Figure 1 is labeled “Prior Art” and shows a plot of dopant concentration versus distance. Ex. 1001, Fig. 1. According to the ’842 patent, Figure 1 “illustrates the relative doping profiles of emitter, base and collector for the two most popular bipolar junction transistors: namely, uniform base (‘A’) and graded base (‘B’).” *Id.* at 2:35–38

Figure 3A of the '842 patent is reproduced below.

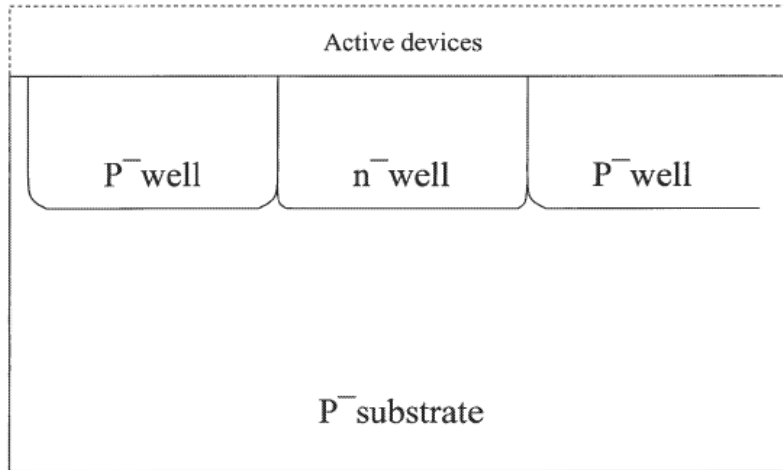


Figure 3A is labeled “Prior art (Twin well CMOS) for a CMOS integrated circuit” (“IC”), and shows a “typical” complementary metal-oxide semiconductor (“CMOS”) very large-scale integrated circuit (“VLSI”) device that employs “a twin well substrate, on which active devices are subsequently fabricated.” Ex. 1001, 2:16–18, Fig. 3A; *see also id.* at 2:41–46 (explaining that Figure 3A shows a “commonly used prior art CMOS silicon substrate[]” having “a typical prior art IC with two wells (one n–well in which p–channel transistors are subsequently fabricated and one p–well in which n–channel transistors are subsequently fabricated)”).

Figure 5A of the '842 patent is reproduced below.

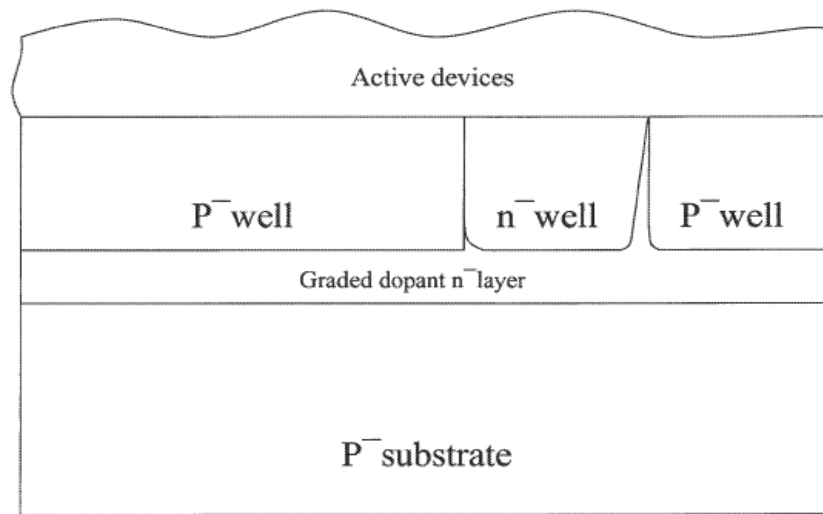


Figure 5A illustrates a cross section of a CMOS silicon substrate with two wells and an underlying layer using embodiments of the invention.

Ex. 1001, 2:54–56. Figure 5A is labeled “[a] CMOS Substrate for digital, mixed[] signal, and sen[s]or[] IC’s.” *Id.* at Fig. 5A. The figure illustrates “a CMOS silicon substrate with two wells and an underlying layer,” which is labeled “Graded dopant n–layer.” *Id.* at 2:54–58, Fig. 5A.

According to the '842 patent, “[s]purious minority carriers can be generated by clock switching in digital VSLI logic and memory ICs.” Ex. 1001, 3:47–48. The '842 patent states that these “unwanted carriers” degrade performance of various types of devices, including digital imaging ICs. *Id.* at 3:49–55. According to the '842 patent, “a novel technique is described” in which “a drift field [is used] to sweep these unwanted minority carriers from the active circuitry at the surface into the substrate in a monolithic die as quickly as possible.” *Id.* at 3:60–64. For example, “[i]n a preferred embodiment, the subterranean n–layer has a graded donor

concentration to sweep the minority carriers deep into the substrate.” *Id.* at 3:64–66.

E. Illustrative Claim

Of the challenged claims, claims 1 and 9 are independent. Claim 1 is illustrative and reproduced below.

1. A semiconductor device, comprising:

[1.1] a substrate of a first doping type at a first doping level having first and second surfaces;

[1.2] a first active region disposed adjacent the first surface of the substrate with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed;

[1.3] a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;

[1.4] transistors formed in at least one of the first active region or second active region; and

[1.5] at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first surface to the second surface of the substrate.

Ex. 1001, 4:45–60 (bracketed designations added by Petitioner (*see* Pet. 13–25)).

F. Asserted Unpatentability Challenges

Petitioner presents the following challenges. Pet. 5.

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1, 2, 4–9, 12–18	103(a) ¹	Kawagoe ²
1, 2, 4–9, 12–18	103(a)	Onoda ³
1, 2, 4–9, 12–18	103(a)	Onoda, Nishizawa ⁴

Petitioner relies on the Declarations of Dr. Stephen Campbell. Ex. 1003; Ex. 1054. Patent Owner relies on the Declaration of Dr. Alexander Glew. Ex. 2057.

G. Timeliness of Petition Under 35 U.S.C. § 315(b)

Pursuant to 35 U.S.C. § 315(b), “[a]n *inter partes* review may not be instituted if the petition requesting the proceeding is filed more than 1 year after the date on which the petitioner, real party in interest, or privy of the petitioner is served with a complaint alleging infringement of the patent.” The question of whether Petitioner is time-barred under § 315(b) is part of the determination of whether to institute an *inter partes* review. *See Thryve, Inc. v. Click-to-Call Techs., LP*, 590 U.S. 45, 54 (2020) (“§ 315(b) expressly governs institution and nothing more”).

¹ The Leahy-Smith America Invents Act, Pub. L. No. 112–29, 125 Stat. 284 (2011) (“AIA”), included revisions to 35 U.S.C. §§ 102 and 103 that became effective after the effective filing date of the challenged claims. *See* Ex. 1001, codes (22), (60). Therefore, we apply the pre-AIA versions of 35 U.S.C. §§ 102 and 103(a).

² U.S. Patent No. 6,043,114, filed September 22, 1997, issued March 28, 2000, to Kawagoe et al. (Ex. 1007, “Kawagoe”).

³ Japanese Unexamined Patent Application Publication No. H8-279598, published Oct. 22, 1996 (Ex. 1043, “Onoda”). A certified translation, to which we cite, is provided. Ex. 1042.

⁴ U.S. Patent No. 5,384,476, filed June 9, 1987 and issued January 24, 1995, to Nishizawa et al. (Ex. 1046, “Nishizawa”).

Patent Owner argues that the Petition should be dismissed because it is untimely. PO Resp. 35–55. In particular, Patent Owner argues Petitioner is in privity with Intel Corp. (“Intel”) and [REDACTED] (collectively “Licensees”), who Patent Owner asserts are time-barred under 35 U.S.C. § 315(b) and licensed under the ’842 patent. *Id.* at 36–55; *see also id.* at 43 (“the Petition is untimely if Petitioner is in privity with Intel or [REDACTED].”). Prior to institution, Patent Owner’s arguments regarding privity were based on several theories, including that Petitioner and Licensees “are ‘preceding and succeeding owners of’ the licensed and/or infringing products,” that Petitioner is a beneficiary of the Licensees’ agreements related to accused products, that Petitioner’s licensed sales encumber otherwise infringing articles, and that Petitioner serves as an “agent” of Licensees by exercising their “have made” rights under the license. *See generally* Prelim. Resp. 32–37.

In our Institution Decision, we determined that Patent Owner had not provided a sufficient factual basis upon which to question Petitioner’s representation that it is not time-barred (Inst. Dec. 20–21), or that Petitioner and Intel, or [REDACTED] were privies, based on any of its theories regarding privity (*id.* at 16–20). We incorporate that analysis here, and reconsider Patent Owner’s contention to the extent it is warranted by subsequent argument and evidence submitted during trial.⁵ *Id.* at 12–21; *see Achates Reference Publ’g. Inc. v. Apple Inc.*, 803 F.3d 652, 658 (Fed. Cir. 2015) (“The Board’s

⁵ With certain exceptions for redacted documents, Patent Owner’s exhibits 2001–2028 were entered prior to Institution and exhibits 2030–2088 were submitted during trial.

reconsideration of the time-bar [in the final determination] is ‘still fair[ly] characterize[ed] as part of the decision to institute.’”) (citations omitted).

Subsequent to the Institution Decision, the only new arguments regarding § 315(b) Patent Owner asserts are: (1) control of prior litigation is not required to establish privity (PO Resp. 39–42); (2) even though Petitioner bears the burden to show that its petition was timely, i.e., Petitioner is not in privity with Intel, or [REDACTED] Petitioner has not attempted to carry its burden (*id.* at 42–48); (3) evidence of record shows that the petition is time-barred (*id.* at 48–55); (4) a finding in Petitioner’s favor would violate Patent Owner’s constitutional right to due process (*id.* at 55–59). We address these arguments below.

Patent Owner’s argument (4) regarding violation of its constitutional right to due process is based on denial of its opportunity to show that Petitioner’s assertions as to its relationships with Licensees is inapposite. PO Resp. 57–59 (citing *Goldberg v. Kelly*, 397 U.S. 254, 269 (1970); *Greene v. McElroy*, 360 U.S. 474, 496 (1959)). Since Patent Owner’s Response, we have allowed and ordered additional discovery concerning privity for the reason discussed below.

On February 11, 2025, the Board entered Final Written Decisions in IPR2023-01242, IPR2023-01243, and IPR2023-01244 (collectively, “the first wave cases”), which involved a different petitioner from the instant case but challenged patents in the same priority chain as, and which claim subject matter similar to, the patent at issue in this proceeding. IPR2023-01242, Paper 84; IPR2023-01243, Paper 82; IPR2023-01244, Paper 83. On April 24, 2025, Patent Owner’s Request for Director Review of those Final Written Decisions was granted, and the Final Written Decisions were

vacated and remanded to the Board for further proceedings. IPR2023-01242, Paper 94; IPR2023-01243, Paper 91; IPR2023-01244, Paper 91 (“Director Review Order” or “Dir. Rev. Order”).

The Director Review Order remands “to the Board with instructions to allow discovery, narrowly tailored to [a] privity issue” relating to an alleged relationship between Petitioner and a non-party, Intel. Dir. Rev. Order 3. In particular, the Director Review Order states that

[t]he Board should then determine on the full record whether Petitioner has met its burden of demonstrating it is not time-barred under § 315(b); that is, whether Patent Owner has produced some evidence to support its argument that Intel should be named as a privity so as to have put the issue into dispute.

Id. (citing *Worlds Inc. v. Bungie, Inc.*, 903 F.3d 1237, 1242–44 (Fed. Cir. 2018)). As the same privity issue arises in the present proceeding, we follow the guidance of the Director Review Order here as well.

On May 8, 2025, we held a teleconference with the parties to discuss the impact of the Director Review Order on the instant cases. During the teleconference, the Board inquired as to whether Patent Owner would request additional discovery pursuant to the Director Review Order vacating and remanding the Final Written Decisions issued in the first wave cases. Paper 43, 2. Patent Owner indicated that it believes the Board made a legal error in its Institution Decisions by failing to shift the burden of production to Petitioner with regard to the issue of privity. *Id.* at 3. As such, Patent Owner did not request additional discovery and indicated that, instead, it would “rest on its papers.” *Id.*; see Paper 58, 4.

Subsequently, in this proceeding (as well as in IPR2024-00468, IPR2024-00469, IPR2024-00470, IPR2024-00551, IPR2024-00552, and

IPR2024-00553), we *sua sponte* issued a Discovery Order (Paper 58, “Disc. Order”), “narrowly tailored,” consistent with the Director Review Order, ordering Petitioner to provide the following discovery to Patent Owner:

- (a) . . . documents [including]:
 - [i. s]ales agreements between Petitioner and Intel for the Intel Accused Products;⁶ and
 - [ii. i]ndemnification agreements between Petitioner and Intel for the Intel Accused Products. *See* IPR[2024-0]1242, [Dir. Rev. Order] 3.
- (b) Documents sufficient to show the asserted privity relationship between Petitioner and Intel, including any new declaration(s) that establish that no documents responsive to Subsection (a) above exist, as well as any documents and new declaration(s) that establish (1) the time by which Petitioner became aware of the Intel litigation referenced in the [Director Review Order]; (2) whether Petitioner was the supplier of any product, or component of a product, accused of infringement in the Intel litigation; and (3) whether Petitioner was in a position to control, or actually controlled, Intel’s defense of that litigation.

Disc. Order 6–7.

In response to our Discovery Order, Petitioner produced and Patent Owner filed the Declaration of Carly Summers (Ex. 2086). Patent Owner cross-examined Ms. Summers and filed a transcript of Ms. Summers’s deposition (Ex. 2087). Patent Owner filed a Patent Owner’s Supplemental Brief Concerning Board-Ordered Discovery (Paper 63, “PO Privity Resp.”), Petitioner filed Petitioner’s Responsive Supplemental Brief (Paper 66, “Pet. Privity Reply”), and Patent Owner filed Patent Owner’s Reply Supplemental

⁶ The “products accused” consist of “the ‘Intel Accused Products’” identified on pages 4–8 of Exhibit 2005, namely, the Intel “products accused of practicing the challenged claims” in Patent Owner’s prior litigation.

Brief Concerning Board-Ordered Discovery (Paper 67, “PO Privity Sur-Reply”). The parties subsequently agreed that oral argument on September 10, 2025 would cover all relevant issues including the privity dispute, and that there need not be a separate telephonic hearing on privity. Paper 68.

Having considered the evidence of record, we determine that Petitioner is not in privity with Intel, and the Petition is not time-barred under 35 U.S.C. § 315(b).

The briefs comingle analyses of the issues of real party in interest (RPI) and privity, and often use the terms interchangeably. *See e.g.*, PO Privity Resp. 1–2; PO Privity Sur-Reply 2. The two terms, however, describe distinct concepts with differing effects under the statute. *See, e.g.*, 35 U.S.C. § 312(a)(2) (petition must identify all RPIs, but not privies). Prior to analyzing the parties’ arguments, we summarize the concept of privity below.

1. Statutory Bar as Nonparty Preclusion

The one-year statutory bar of § 315(b) “helps to ensure that *inter partes* review provides a quick and cost effective alternative to litigation, and is not used as a tool for harassment or litigation gamesmanship.” *Johnson Health Tech. Co. v. Icon Health & Fitness, Inc.*, Case IPR2014-01242, Paper 16 at 3 (PTAB Feb. 11, 2015) (citing H.R. REP. NO. 112-98 at 48, *as reprinted in* 2011 U.S.C.C.A.N. at 78). In this sense, § 315(b) is analogous to the common-law doctrines of claim preclusion and issue preclusion, which “preclude parties from contesting matters that they have had a full and fair opportunity to litigate,” thereby “protect[ing] their

adversaries from the expense and vexation attending multiple lawsuits, conserv[ing] judicial resources, and foster[ing] reliance on judicial action by minimizing the possibility of inconsistent decisions.” *Montana v. United States*, 440 U.S. 147, 153–54 (1979). Our Practice Guide, therefore, looks to these doctrines of preclusion in interpreting the language of § 315(b). See Consolidated Trial Practice Guide (“Practice Guide” or “CTPG”) ⁷ at 12–17.

Like the common-law preclusion doctrines, the preclusive effect of § 315(b) also extends beyond those who were parties to the prior lawsuit. Because nonparty preclusion risks binding those who have not had a full and fair opportunity to litigate, the Supreme Court has cautioned that there is a general rule against nonparty preclusion, subject only to limited exceptions. See *Taylor v. Sturgell*, 553 U.S. 880, 892–93 (2008). In *Taylor*, while noting that it was not a “definitive taxonomy” (*id.* at 893 n.6), the Court set forth a list of six “categories” under which nonparty preclusion may apply.⁸

(1) “[A] person who *agrees to be bound* by the determination of issues in an action between others is bound in accordance with the terms of his agreement.” *Id.* at 893.

(2) “[N]onparty preclusion may be justified based on a variety of *pre-existing substantive legal relationships* between the person to be bound and a party to the judgment,” such as “preceding and succeeding owners of property, bailee and bailor, and assignee and assignor.” *Id.* at 894.

(3) “[I]n certain limited circumstances,” such as class actions, “a nonparty may be bound by a judgment because she was *adequately represented* by someone with the same interests

⁷ Available at www.uspto.gov/patents/ptab/trial-practice-guide.

⁸ For clarity, we omit internal quotation marks and citations throughout the list of categories enumerated in *Taylor*, add emphasis on certain key phrases, and generally cleaned up the quotations.

who was a party to the suit.” *Id.* The Court later elaborated that this exception applies only if there are “special procedures to protect the nonparties’ interests, or an understanding by the concerned parties that the first suit was brought in a representative capacity.” *Id.* at 900.

(4) “[A] nonparty is bound by a judgment if she *assumed control* over the litigation,” because that person “has had the opportunity to present proofs and argument . . . even though he was not a formal party to the litigation.” *Id.* at 895.

(5) “[A] party bound by a judgment may not avoid its preclusive force by *relitigating through a proxy*,” such as “when a nonparty later brings suit as an agent for a party who is bound by a judgment.” *Id.*

(6) “[A] *special statutory scheme*,” such as bankruptcy or probate, “may expressly foreclose successive litigation by nonlitigants . . . if the scheme is otherwise consistent with due process.” *Id.*

Having listed these categories, the Court then held that a broader doctrine of nonparty preclusion, termed “virtual representation,” was inconsistent with Federal common law, and risked violating due process. *Id.* at 898–900.

Therefore, nonparty preclusion cannot be based on mere “identity of interests and some kind of relationship between parties and nonparties.” *Id.* at 901.

2. *Caselaw on Privity*

“[T]he mere existence of some relationship between a petitioner and another entity is not sufficient” to place that petitioner in privity with that entity. *Google LLC v. DDC Technology, LLC*, IPR2023-00707, Paper 27 at 37 (PTAB Oct. 25, 2023). Instead, “that relationship must be related to [an earlier] lawsuit and be sufficiently close that it can be fairly said *the petitioner had a full and fair opportunity to litigate the validity of the patent*

in that lawsuit.” Id. (emphasis added). In other words, privity concerns “whether the petitioner and the prior litigant’s relationship—as it relates to the [earlier] lawsuit—is sufficiently close that it can be fairly said that the petitioner had a full and fair opportunity to litigate the validity of the patent in that lawsuit,” or “whether the petitioner is simply serving as a proxy to allow another party to litigate the patent validity question that the other party raised in an earlier filed litigation.” *WesternGeco LLC v. ION Geophysical Corp.*, 889 F.3d 1308, 1319 (Fed. Cir. 2018).

Though expansive, the concept of privity has boundaries set by due process. As the Court held in *Taylor*, extending the preclusive concept of privity to those in “virtual representation,” through identity of interest and a determination that the relationship of the parties is “‘close enough’ to bring the second litigant within the judgment,” is impermissible. *See Taylor*, 553 U.S. at 898. Only if the nonparty can be said to have had a “full and fair opportunity to litigate” can that nonparty be precluded as a privy. *Id.* at 892–93; *see also Aspex Eyewear, Inc. v. Zenzi Optical, Inc.*, 713 F.3d 1377, 1382 (Fed. Cir. 2013) (“[a] full and fair opportunity to litigate is the touchstone of any preclusion analysis.”).

Courts examine different aspects of the parties’ relationship, depending on the issue for which privity is being asserted. *See Int’l Nutrition Co. v. Horphag Research, Ltd.*, 220 F.3d 1325, 1329 (Fed. Cir. 2000) (“[a] variety of relationships between two parties can give rise to the conclusion that a nonparty to an action is ‘in privity’ with a party to the action”). For example, the parties’ contractual relationship (privity of contract) regarding a product is relevant when determining whether an injunction against the

sale of that product applies. *See In re Cyclobenzaprine Hydrochlorine Extended-Release Capsule Patent Litigation*, 504 F. App'x 900, 906 (Fed. Cir. 2013) (unpublished). In other situations—for example, in the case of a judgment with respect to a particular property interest—the relationship between the parties with respect to the transfer of the property may be the focus. *See Int'l Nutrition*, 220 F.3d at 1329. Therefore, the same two parties may be in privity for certain purposes, but not for others. *Id.*

In the context of § 315(b), the goal of preclusion is to prevent successive challenges to a patent by those who previously have had the opportunity to make such challenges in prior litigation. As such, the focus of our privity inquiry is on the relationship between the parties *during the prior lawsuit*. In other words, we ask whether the instant petitioner and the prior litigant's relationship—as it relates to the lawsuit—is sufficiently close that it can be fairly said that the petitioner has had a full and fair opportunity to litigate the validity of the patent in the lawsuit.

In this sense, our privity inquiry will typically fall into *Taylor*'s fourth category of nonparty preclusion, which applies to situations in which the petitioner “has had the opportunity to present proofs and argument” such that it can be said to have “assumed control” over the action. *Taylor*, 553 U.S. at 895. Our Practice Guide reflects this, noting that control is a “common consideration” in the privity inquiry. CTPG 16.

Furthermore, we note that *actual* assumption of control of the lawsuit is not necessary for a finding of privity; the opportunity, or legal right, to assume control is sufficient. “Substantial control . . . connotes the availability of a significant degree of effective control in the prosecution or defense of the case—what one might term, in the vernacular, the power—

whether exercised or not—to call the shots.” *Gonzalez v. Banco Central Corp.*, 27 F.3d 751, 758 (1st Cir. 1994); *see Arris Group, Inc. v. C-Cation Techs., LLC*, Case IPR2014-00746, slip op. at 10 (PTAB Nov. 24, 2014) (Paper 22) (inquiring into whether party exercised, or could have exercised, control over District Court action); *see also* Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,759 (Aug. 14, 2012) (quoting 18A Charles Alan Wright, Arthur R. Miller & Edward H. Cooper, *Federal Practice & Procedure* § 4451 (2d ed. 2011)) (“control generally means that ‘it should be enough that the nonparty has the actual measure of control or *opportunity to control* that might reasonably be expected between two formal coparties’”) (emphasis added).

Finally, privity is based on “flexible and equitable considerations,” and, therefore, neither the Practice Guide nor our decisions set any bright-line test for when privity exists. CTPG 14. Nor should the preceding discussion be understood to mandate that all § 315(b) privity relationships must fall within the fourth “assumed control” category set forth in *Taylor*. Common to our cases, however, is a focus on the relationship between the parties in the context of the prior lawsuit, and an inquiry as to whether the petitioner’s relationship with the prior litigant was sufficiently close that it can be said that the petitioner had, or will have, a full and fair opportunity to litigate the validity of the patent in that prior action.

If we are satisfied that petitioner has “enjoyed its day in court” through its relationship with the litigant, it is fair to consider the parties to be privies. In *Taylor*, the Court held that

a party bound by a judgment may not avoid its preclusive force by relitigating through a proxy. Preclusion is thus in order when

a person who did not participate in a litigation later brings suit as the designated representative of a person who was a party to the prior adjudication . . . [I]t also seems clear that preclusion is appropriate when a nonparty later brings suit as an agent for a party who is bound by a judgment.

Taylor, 553 U.S. 895.

3. *Petitioner's Arguments*

Petitioner contends that “[t]here is no privity between Petitioner and Intel,” and “[a]ccordingly, the Petitions are not time-barred.” Pet. Privity Reply 15. According to Petitioner, “even if Petitioner had known about and wanted to control the Intel litigation, it could not have because Petitioner has no contractual agreements with Intel that would give it the right of such control.” Pet. Privity Reply 9 (citing Ex. 2086 ¶¶ 6, 7). Petitioner contends that “[t]he legal relationship factors also weigh heavily against privity because Petitioner does not have any indemnity or sales agreements with Intel and is not the supplier to Intel for any product or component which was accused in the Intel litigation.” *Id.* at 10–11; *see* Ex. 2086 ¶¶ 6–8); Ex. 2085, 35:1–4.

Petitioner contends that

in *WesternGeco*, the Federal Circuit affirmed that no privity existed even when there was an indemnification clause in a sales agreement because the clause did not specify the meaning of “‘indemnify’ as requiring [the party] . . . to pay for any litigation defense expenses or for any damages related to infringement.” If no privity exists even when an indemnification clause and sales agreement exist, then certainly, no indemnification or sales agreements push the present situation further away from a finding of privity.

Pet. Privity Reply 11 (citing *WesternGeco*, 889 F.3d at 1321) (alterations by Petitioner)). Petitioner clarifies that its Declarant, Ms. Carly Summers, “did

not merely look for sales and indemnity agreements just for the Intel Accused products (‘IAPs’), but instead investigated if Petitioner had *any* sales or indemnity agreements with Intel.” *Id.* at 12 (citing PO Privity Resp. 5–6; Ex. 2086 ¶¶ 6, 7 (stating there are “no sales [and indemnification] agreements at all between Petitioner and Intel” (emphasis omitted))).

Petitioner asserts that, because its “products were not implicated in the Intel lawsuit,” “Petitioner would have had no grounds to step in even if there was such an obligation.” Pet. Privity Reply 10.

Petitioner’s Declarant testified that “Petitioner first learned of Patent Owner’s litigation against Intel on or about May 26, 2023,” (Ex. 2086 ¶ 10) and Petitioner asserts that this “was a month *after* the Intel case settled (and was after Intel’s own one-year time bar had already run” (Pet. Privity Reply 9). Thus, according to Petitioner, “[t]he control factor weighs against privity because Petitioner did not control or direct the lawsuit between Patent Owner and Intel.” Pet. Privity Reply 9. Declarant Summers also testified that “Petitioner had no knowledge of, or involvement in, Intel’s defense in its litigation against Patent Owner. Petitioner did not actually control, nor was it in a position to control, Intel’s defense in that litigation.” Ex. 2086 ¶ 12. “It is common sense,” according to Petitioner, that “Petitioner could not have controlled the Intel case when it did not even know it was happening.” Pet. Privity Reply 10. Petitioner further contends that “there is ‘no evidence to suggest that [Petitioner] . . . directed, funded, controlled, or influenced’ the Intel case.” *Id.* (quoting *WesternGeco*, 889 F.3d at 1320).

4. Patent Owner’s Arguments

Patent Owner argues that it “has presented far more than ‘some evidence’ that time-barred parties, including Intel,□ should have been named

as RPI in the Petition.” PO Privity Resp. 2. Patent Owner also argues that it “maintains that Petitioner is in privity with both [REDACTED], two other time-barred parties,” and “that discovery should have been granted as to these parties for at least the reasons presented in the Joint Paper Concerning Additional Discovery in the Wave 1 (*onsemi*) IPRs.” *Id.* at 2 n.2 (citing IPR2023-01242, Paper 108 at 2–5). We address this argument below.

Patent Owner argues that its evidence confirms that MPS is a component supplier to Intel and “[a]s a result, Petitioner received a sublicense as a ‘have made vendor’ to make and sell products to Intel under Intel’s license with [Patent Owner].” PO Privity Resp. 2–3 (citing Prelim. Reply 5; Exs. 2017–2019; Ex. 2011, 3). According to Patent Owner, Petitioner’s Declarant “testified that ‘MPS sells some custom products,’” and “confirmed [Patent Owner]’s longstanding belief that Petitioner’s sales ‘contract include an indemnity clause against patent infringement.’” *Id.* at 3 (quoting Ex. 2087, 34:11–17, 31:11–15). Patent Owner also contends that it “has previously submitted evidence that Petitioner ‘maintains a staff of applications engineers who work directly with [] customer’ engineers.” *Id.* (quoting Ex. 2022, 6).

Patent Owner contends that the position of Petitioner’s Declarant “is undermined by two critical admissions: Petitioner is a **component** supplier and has an **indirect** sales model,” and “[a]s a result, she failed to present to the Board a comprehensive account of Petitioner’s relationship with Intel under the guise of conducting a complete and thorough ‘investigation.’” PO Privity Resp. 6. Patent Owner argues that Petitioner’s Declarant did not investigate *indirect* sales of parts or components to Intel, nor did she consult with the parties or people who would possess relevant information. *Id.* at 6–

13; *see id.* at 7 (quoting Ex. 2086, 16:21–17:2). In particular, Patent Owner argues that “Ms. Summers testified that she did not know whether *any* MPS components are included in *any* Intel devices and, as discussed in more detail below, she did not avail herself of any opportunity to learn the answer to that question.” *Id.* at 9. Patent Owner also takes the position that “Ms. Summers clearly admitted that she does not ‘know whether the Intel Core i5-12400 processor’—or any of the other processors included in the list of IAPs—‘includes any element designed or manufactured’ by MPS.” *Id.* (citing Ex. 2087, 25:5–26:2).

Patent Owner argues that “[n]ot only does Ms. Summer’s conclusory declaration fail to satisfy the Order, but Petitioner offered no accompanying documents to substantiate the claims made by its declarant.” PO Privity Resp. 13. According to Patent Owner,

Ms. Summers testified about numerous issues where, presumably, she would have come across pre-existing documents or would have generated documents as part of the investigation. For example, she described how she “searched” for all sales and indemnification agreements concerning the IAPs, but did not attach any computer printouts or other documents confirming that no such agreements existed. Relatedly, she mentioned searching her own files, emails, and those of “every employee in Petitioner’s legal department,” and instructed the “IT department [to] search the archived files and e-mails of . . . former employees.” Ms. Summers provided no proof whatsoever to corroborate her declaration.

Id. at 14 (citing Ex. 2086⁹ ¶¶ 6, 7, 9).

⁹ Patent Owner erroneously cites Ex. 2087 instead of Ex. 2086.

5. *Analysis of the Parties' Arguments*

Our analysis below concerns whether Petitioner is in privity with Intel. *See* Dir. Rev. Order 3. *Worlds* is a seminal case that addresses burdens on the parties when § 315 is at issue. In *Worlds*, the Court held that “an IPR petitioner’s initial identification of the real parties in interest should be accepted unless and until disputed by a patent owner.” *Worlds*, 903 F.3d at 1242. The Court also “agree[d] that a patent owner must produce *some evidence* to support its argument that a particular third party should be named a real party in interest.” *Id.* “There can be no doubt that the IPR petitioner bears the ultimate burden of persuasion to show that its petitions are not time-barred under § 315(b) based on a complaint served on an alleged real party in interest more than a year earlier.” *Id.* Although *Worlds* addressed RPI, it more broadly discussed § 315 in general, which covers both RPI and privity.

In the present proceeding, Patent Owner did not produce “some evidence” tending to show that Petitioner is in privity with Intel, and the burden never shifted to Petitioner. Even if Patent Owner did produce sufficient evidence to put the relationship between Petitioner and Intel into dispute, the evidence adduced during trial sufficiently supports Petitioner’s position and, in particular, satisfies Petitioner’s burden to show it is not time-barred under § 315(b).

The evidence adduced during trial does not support a finding that the relationship between Petitioner and Intel is sufficiently close that both should be bound by the trial outcome and related estoppels, nor does it suggest, without more, that the parties were litigating either the district court action or the IPRs as proxies for one another. In a nutshell, the record is

devoid of evidence tending to show that Petitioner controlled, or had an opportunity to control, the litigation. To the contrary, as explained below, the only record evidence on point supports Petitioner's position that it did not control, or have any opportunity to control, the litigation.

Petitioner contends that "it had no knowledge of the lawsuit between Patent Owner and Intel ('the Intel litigation') until after that lawsuit had concluded," "its components were not implicated in the Intel litigation," and "it did not participate in, control, or have an opportunity to control, the Intel litigation in any way." Pet. Privity Reply 1. According to Petitioner's Declarant, Petitioner "first learned of Patent Owner's litigation against Intel on or about May 26, 2023," "as it began to investigate the allegations in, and merits of, Patent Owner's May 26, 2023 complaint against Petitioner." Ex. 2086 ¶ 10. She also testified that "Petitioner had no knowledge of, or involvement in, Intel's defense in its litigation against Patent Owner" and "did not actually control, nor was it in a position to control, Intel's defense in that litigation." *Id.* ¶ 12.

In light of the assertions of lack of *actual* participation in and control of, or opportunity to control, the Intel litigation by Petitioner, and the lack of evidence as to whether Intel controlled or had an opportunity to control Petitioner's decisions in the Petitioner-initiated IPRs, we next consider Petitioner's and Intel's relationship, as it relates to the Intel litigation. We consider whether that relationship is sufficiently close such that the Intel litigation would have given Petitioner a full and fair opportunity to litigate the validity of the challenged claims of the '842 patent or whether Petitioner is "simply serving as a proxy to allow" Intel "to litigate the patent validity question that" Intel "raised in an earlier filed litigation." *See WesternGeco*,

889 F.3d at 1319, 1320 (“[T]he privity analysis is broader than simply inquiring whether PGS controlled or had an opportunity to control ION’s decisions in the ION patent infringement litigation, or whether ION controlled or had an opportunity to control PGS’s decisions in the PGS-initiated IPRs.”).

In response to the Board’s Discovery Order, Petitioner produced evidence, none of which supports Patent Owner’s argument that Intel should be named as a privy. *See* Dir. Rev. Order 3–4. It is worth emphasizing here that, contrary to Patent Owner’s position (*see, e.g.,* PO Privity Resp. 1–2), the Director did not indicate that Patent Owner had met its burden of production under the *Worlds* decision. To the contrary, the Director ordered the Board to allow discovery to determine, on the full record, “whether Patent Owner has produced some evidence to support its argument that Intel should be named as a privy *so as to have put the issue into dispute.*” Dir. Rev. Order 3 (emphasis added) (citing *Worlds*, 903 F.3d at 1242–44).

We are not persuaded that Petitioner is in privity with Intel because the evidence of record supports the following findings:

- (1) [Petitioner] has no sales or indemnity agreements with Intel,
- (2) it does not supply any products to Intel, (3) it had no knowledge of [the Intel litigation] until after that lawsuit had concluded, (4) its components were not implicated in the Intel litigation, and (5) it did not participate in, control, or have an opportunity to control, the Intel litigation in any way.

Pet. Privity Reply 1.

Notwithstanding Patent Owner’s arguments, addressed below, we find persuasive Petitioner’s Declarant’s testimony. Specifically, Declarant Summers has been Senior Corporate Counsel in MPS since August 2021,

and her responsibilities include “leading the negotiation, drafting, and preparation of commercial contracts, including vendor, licensing, and supply agreements” and “support[ing] Petitioner’s Supply Chain and Sales team functions, including identifying legal risks and proposing strategies to safeguard Petitioner’s interests.” Ex. 2086 ¶¶ 1, 3. We are persuaded Declarant Summers’ experience supports that she had sufficient knowledge to attest to her testimony that “Petitioner’s principal customers are contract manufacturers located in Asia, rather than downstream branded companies such as Intel,” “Petitioner did not sell to Intel, or supply Intel with, any of the Intel Accused Products,” and “Petitioner was not the supplier to Intel of any product, or component of a product, accused of infringement in the Intel litigation.” *Id.* ¶ 8.

Petitioner persuasively contends that Patent Owner’s attack against Declarant Summers “for not knowing whether Petitioner’s products could somehow, through some unknown, hypothetical chain of third-party transactions, wind up in an [Intel Accused Product (IAP)]” is “irrelevant to the privity analysis” as “Patent Owner does not cite a case showing that a party’s product which was not implicated as an accused product in another lawsuit was a dispositive factor for finding privity.” Pet. Privity Reply 13 (citing PO Privity Resp. 10–13); *see also id.* (“[D]espite having years to investigate [the IAPs], Patent Owner has never claimed, much less produced **any** evidence, that **any** of the IAPs contains **any** of Petitioner’s products.”). Petitioner also persuasively contends that in response to Patent Owner’s attack of Declarant Summers “for not investigating whether there were indirect sales from Petitioner to Intel,” “offering a product that some unknown downstream customer, through some unknown string of

transactions, might ultimately supply to Intel, cannot serve as the basis for finding privity.” *Id.* at 13–14 (citing PO Privity Resp. 4–10). Petitioner persuasively argues that “even if Patent Owner had produced evidence that any of Petitioner’s products were in any of the IAPs, that fact would carry little weight in the privity analysis and would certainly not outweigh the predominant factors—control, indemnity and sales agreements, and fairness—which weigh heavily against a finding of privity,” especially considering the unrebutted assertion that “[t]he IAPs were Intel-fabricated microprocessors, not low-level components such as Petitioner’s tiny power converters and regulators.” *Id.* at 15 (citing Ex. 2009 ¶ 65; Ex. 2005; Pet. Reply 26).

We see no issue as to Petitioner’s inability to provide sales agreements or other documents that would prove a negative—that Petitioner did not sell the IAPs or components thereof to Intel. Patent Owner alleges that Petitioner’s Declarant limited her investigation to a subset of the issues highlighted in the Board’s order and did not investigate indirect sales of parts or components to Intel. PO Privity Resp. 5–10. According to Patent Owner, for example, Declarant “Summers clearly admitted that she does not ‘know whether the Intel Core i5-12400 processor’—or any of the other processors included in the list of IAPs—‘includes any element designed or manufactured’ by MPS” and “[s]he has never ‘seen a parts list for any of these processors,’ and did not know whether ‘anyone [else] in-house’ had either.” *Id.* at 9 (citing Ex. 2087, 25:5–26:2, 26:8–13). This is beyond the scope of the Discovery Order, which required sales and indemnifications agreements “*between* Petitioner and *Intel* for the Intel Accused Products,” “as well as any documents and new declaration(s) that establish . . . whether

Petitioner was the supplier of *any product, or component of product, accused of infringement in the Intel litigation.*” Disc. Order 6–7 (emphasis added). The Discovery Order did not specifically require Petitioner to adduce evidence concerning whether Petitioner supplied products or components to Intel for use in or with other Intel products not accused in the Intel Litigation.

Indirect Sales and Third-Party Resellers

Patent Owner takes the position that Petitioner’s Declarant’s investigations included insufficient efforts to learn whether any of its parts or products are or were, in any way, incorporated into Intel processors in post-transfer, downstream transactions because Declarant “Summers never consulted with the sales or engineering teams at MPS to determine the extent of Petitioner’s relationship with Intel,” and did not “reach out to anyone in sales or engineering to find out whether or not MPS components are included in Intel devices.” PO Privity Resp. 12 (quoting Ex. 2087, 19:10–20:2). The Discovery Order did not specifically require Petitioner to produce evidence beyond agreements between Petitioner and Intel concerning products accused of practicing the challenged claims. Disc. Order 6–7. Stated differently, the Discovery Order did not require Petitioner to produce evidence of any *indirect* sales of its components or products to Intel that occurred after Petitioner surrendered control of the items. Disc. Order 6–7. Such evidence, in any case, would be insufficient to establish privity between Petitioner and Intel based on control of, or an opportunity to control, the relevant litigation.

According to Patent Owner, Petitioner’s Declarant “confirmed [Patent Owner]’s longstanding belief that Petitioner’s sales ‘contract include an

indemnity clause against patent infringement.” PO Privity Resp. 3 (citing Ex. 2087, 31:11–15). Irrespective of whether the general nature of Petitioner’s contracts include an indemnity clause, Petitioner’s Declarant’s testimony persuasively “confirm[s] that . . . ‘[t]here are no indemnification agreements at all *between Petitioner and Intel*.’” Pet. Privity Reply 10 (citing Ex. 2086 ¶ 7) (emphasis added).

Incorporation of Petitioner’s Products into Non-Accused Intel Products

To the extent Patent Owner is arguing that Petitioner’s investigation is lacking for failure to determine any potential use of Petitioner’s products in *non-accused* Intel products (*see, e.g.*, PO Privity Resp. 2–3), this argument is unavailing. A “manufacturer-customer relationship alone does not establish privity” at least because any such relationship does not concern supplying *IAPs or components thereof*. *See WesternGeco*, 889 F.3d at 1321 (“Regarding the pre-suit business alliance, the Board found that ION and PGS had a contractual and fairly standard customer-manufacturer relationship regarding the accused product. This finding does not necessarily suggest that the relationship is sufficiently close”). The Discovery Order did not specifically require evidence of sales of components to Intel for integration in non-accused Intel products because, even if such evidence existed, it would be insufficient to establish privity between Petitioner and Intel based on control of, or an opportunity to control, the relevant litigation.

Providing Custom Products to Customers

To the extent that Patent Owner suggests that, because “Ms. Summers, Petitioner’s declarant and Senior Corporate Counsel, testified that ‘MPS sells some custom products,’ and [Patent Owner] has previously submitted evidence that Petitioner ‘maintains a staff of applications

engineers who work directly with [] customers’ engineers,” such collaboration implies privity, presumably with Intel, we disagree. PO Privity Resp. 3 (quoting Ex. 2087 at 34:11–17, Ex. 2022, 6). Generally collaborating and making custom products is not dispositive and, instead, what matters for privity is that Petitioner did not make the Intel Accused Products or components thereof such that Petitioner was in a position to or had opportunity to control the relevant litigation and should not be provided a second bite at the same apple. *See, e.g., WesternGeco*, 889 F.3d at 1319–22 (the parties “had a contractual and fairly standard customer-manufacturer relationship regarding the accused product,” which “does not necessarily suggest that the relationship is sufficiently close that both” parties should be considered to be in privity); *Wi-Fi One, LLC v. Broadcom Corp.*, 887 F.3d 1329, 1340–41 (Fed. Cir. 2018)(same); *Samsung Elec. Co. Ltd. v. Netlist Inc.*, IPR2022-00615, Paper 64 at 22–26 (PTAB June 30, 2023)(same).

We did not order a particular style or depth of investigation (*see* Disc. Order 6–7), nor do we discern that Petitioner’s investigations were in any way insufficient. In particular, we disagree with Patent Owner’s position that compliance with the Discovery Order required Petitioner’s Declarant to undertake discovery from Intel to determine whether any IAPs that were accused of infringement in the related litigation included components sold or manufactured by Petitioner, much less contact distributors, manufacturing fabrication plants, or corporate affiliates as part of their investigation to discover whether any of Petitioner’s products ultimately were included in such IAPs. *See, e.g.,* PO Privity Resp. 10–13. The Declaration produced by Petitioner is sufficient to comply with the Discovery Order.

When Patent Owner was inquired as to whether Patent Owner would request additional discovery pursuant to the Director's Decision vacating and remanding the Final Written Decisions issued in the first wave cases, Patent Owner indicated it would not seek additional discovery, preferring instead to "rest on its papers." Disc. Order 4 (citations omitted). Thus, it is not clear to us what Petitioner could have produced that would satisfy Patent Owner's demands for an adequate investigation. Moreover, we are not apprised of, and can discern no evidence of inaccuracies, inconsistencies, or any other impropriety, particularly as Petitioner's Declarant testified under penalty of perjury.

In view of the above, the evidence adduced during trial does not support Patent Owner's argument that Intel should be named as a privy so as to put the issue into dispute. *See Dir. Rev. Order 3* (making plain that the question on remand is whether Patent Owner has met that burden of production). Moreover, even if Patent Owner had met their burden of production, the totality of evidence adduced during trial does not support a finding that the relationship between Petitioner and Intel is sufficiently close that both should be bound by the trial outcome and related estoppels, nor does it suggest, without more, that the parties were litigating either the district court action or the IPRs as proxies for one another. Further, the record is devoid of evidence that Petitioner had any opportunity to control the Intel litigation.

As for Patent Owner's argument that it "maintains that Petitioner is in privity with both [REDACTED], two other time-barred parties," and "that discovery should have been granted as to these parties for at least the reasons presented in the Joint Paper Concerning Additional Discovery in the Wave 1

(*onsemi*) IPRs,” we decline to address this argument. PO Privity Resp. 2 n.2 (citing IPR2023-01242, Paper 108 at 2–5). The Director Review Order made clear that the Board’s Final Written Decisions were remanded to consider issues of privity with respect to only Intel and we decline to enlarge the scope of the “narrowly tailored” discovery set forth in the Director Review Order. *See* Dir. Rev. Order 3.

██████████

According to Patent Owner, “Intel and ██████████ were served with a complaint alleging infringement of the Challenged Patent on February 1, 2022” and “██████████ was an RPI to the First Amended Complaint against ██████████ (served by ECF on April 29, 2022).” Paper 11, 28 (citing Ex. 2002, 2, 4; Ex. 2001; Ex. 2003; Ex. 2008, 7). “Thus,” Patent Owner contends that “the Petition is untimely if Petitioner is in privity with Intel *or* ██████████.” *Id.* (emphasis added). In our Order Authorizing Supplemental Discovery and Briefing of June 27, 2025, we noted that “the Board conducted a teleconference with the parties in the above-captioned proceedings,” IPR2024-00468, IPR2024-00469, IPR2024-00470, IPR2024-00550, IPR2024-00551, IPR2024-00552, and IPR2024-00553. Disc. Order 4.

During the teleconference, the Board inquired as to whether Patent Owner would request additional discovery pursuant to the Director’s Decision vacating and remanding the Final Written Decisions issued in the first wave cases. Patent Owner indicated it would not seek additional discovery, preferring instead to “rest on its papers.”

Id. (citing IPR2024-00468, Paper 63, 2–3). That we chose to *sua sponte* craft a post-institution, discovery order on Patent Owner’s behalf, without

sufficient input from Patent Owner, can hardly leave the Board to blame if Patent Owner did not obtain the discovery materials and briefing it sought.

██████ is not alleged to be an RPI or privy of Petitioner. *See* PO Resp. 36 (identifying Licensees as ████████ Intel, and ████████). Rather, ████████ is alleged to be an RPI of an alleged RPI—██████ (*see* PO Resp. 35–36)—a degree of separation that is not contemplated by the clear language of the statute. Thus, Patent Owner’s arguments as to ████████ are unavailing.

II. ANALYSIS

A. Legal Standards

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

A claim is unpatentable under 35 U.S.C. § 103(a) if “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” 35 U.S.C. § 103(a). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when present, objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

To show obviousness, it is not enough to merely show that the prior art includes separate references covering each separate limitation in a challenged claim. *Unigene Labs., Inc. v. Apotex, Inc.*, 655 F.3d 1352, 1360 (Fed. Cir. 2011). “Rather, obviousness requires the additional showing that a person of ordinary skill at the time of the invention would have selected and combined those prior art elements in the normal course of research and development to yield the claimed invention.” *Id.* (citing *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007)). “This is so because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known.” *KSR*, 550 U.S. at 418–19. On the other hand, an obviousness analysis “need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.” *Id.* at 418; accord *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1259 (Fed. Cir. 2007). Nevertheless, “[a] factfinder should be aware, of course, of the distortion caused by hindsight bias and must be cautious of arguments reliant upon *ex post* reasoning.” *KSR*, 550 U.S. at 421.

B. Level of Ordinary Skill in the Art

In determining the level of ordinary skill in the art, various factors may be considered, including the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995).

According to Petitioner,

[a] person of ordinary skill in the art (“POSITA”) of the subject matter of the ’842 Patent would have had a Bachelor’s degree in electrical engineering, material science, applied physics, or a related field, and four years of experience in semiconductor design and manufacturing or equivalent work experience. Additional education might compensate for a deficiency in experience, and vice-versa.

Pet. 5 (citing Ex. 1003 ¶ 18).

Patent Owner argues that

[a] person of ordinary skill in the art (POSITA) in the technology field of the Challenged Patent would be a person with at least a Bachelor’s of Science degree in electrical or computer engineering, materials science, chemical engineering, applied physics, or a related field, with emphasis on semiconductor manufacturing, or an equivalent degree, and at least four years of experience in semiconductor design and manufacturing. Additional education in a relevant field or industry experience may compensate for a deficit in one of the other aspects of the requirements stated above.

PO Resp. 8 (citing Ex. 2057 ¶¶ 17, 18).

Petitioner’s and Patent Owner’s definitions for the level of ordinary skill in the art are substantially similar. In light of the record before us, we adopt Petitioner’s proposal regarding the level of ordinary skill in the art. Based on our review of the ’842 patent and the prior art of record, we determine that the definition offered by Petitioner comports with the qualifications a person would have needed to understand and implement the teachings of the ’842 patent and the prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (explaining that specific findings regarding ordinary skill level are not required “where the prior art itself reflects an

appropriate level and a need for testimony is not shown”) (quoting *Litton Indus. Prods., Inc. v. Solid State Sys. Corp.*, 755 F.2d 158, 163 (Fed. Cir. 1985)). Patent Owner does not argue, nor do we determine, that the outcome of our Decision depends on which party’s definition is selected.

C. Claim Construction

In an *inter partes* review, we construe claim terms according to the standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–17 (Fed. Cir. 2005) (en banc). 37 C.F.R. § 42.100(b) (2023). Under *Phillips*, claim terms are afforded “their ordinary and customary meaning.” *Phillips*, 415 F.3d at 1312. “[T]he ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention.” *Id.* at 1313. “Importantly, the person of ordinary skill in the art is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification.” *Id.*

Neither party proposes any claim terms for *express* construction. Pet. 7; PO Resp. 8–9 (citing Ex. 2057 ¶¶ 20–25, 50). However, Patent Owner implicitly construes “graded dopant concentration” and “aid carrier movement” to require carrier movement, and Petitioner disagrees. PO Resp. 9–20; Pet. Reply 1–15. We address that implicit construction in our analysis below. *Infra* §§ II.E–II.G.

After considering the arguments and information presented during trial, we agree that we do not need to expressly construe any terms in order to decide the disputed issues. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (citing *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (“[O]nly

those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.”)).

*D. Objective Indicia of Nonobviousness*¹⁰

Patent Owner alleges that a license agreement with RPX Corp. (“RPX”) (“the RPX license”) that covers the patent family including the ’842 patent is evidence supporting the objective indicia of nonobviousness. PO Resp. 32–34. Patent Owner further argues that because the licensees, [REDACTED] approached Patent Owner through RPX without threat of litigation against them, the RPX license agreement is especially probative of non-obviousness. *Id.* at 4–5, 32–33. Patent Owner further argues that its invention is “part and parcel” of the RPX license because all of the claims of the licensed patents relate to “using graded dopants to move carriers at the ‘surface’ or ‘active region’ further down into the device.” *Id.* at 33 (citing-in-part Ex. 1001).

Patent Owner bears the burden of establishing that a nexus exists between the objective evidence and the claimed invention. *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019). Nexus is a legally and factually sufficient connection between the objective evidence and the claimed invention, such that the objective evidence should be considered in determining non-obviousness. *Demaco Corp. v. F. Von Langsdorff Licensing Ltd.*, 851 F.2d 1387, 1392 (Fed. Cir. 1988). “A nexus may not exist where, for example, the merits of the claimed invention were ‘readily available in the prior art.’” *ClassCo, Inc. v. Apple, Inc.*, 838 F.3d 1214, 1220

¹⁰ In Section II.D, we refer to the sealed version of the Patent Owner Response (Paper 32).

(Fed. Cir. 2016) (quoting *Richdel, Inc. v. Sunspool Corp.*, 714 F.2d 1573, 1580 (Fed. Cir. 1983)).

“Unlike products, which may incorporate numerous features beyond those claimed or described in a patent and therefore may require careful parsing to establish a nexus, actual licenses to the subject patent do not demand the same, as they are, by their nature, directly tied to the patented technology.” *Ancora Techs. Inc. v. Roku Inc.*, 140 F.4th 1351, 1362 (Fed. Cir. 2025) (citing *Laser Dynamics, Inc. v. Quanta Computer, Inc.*, 694 F.3d 51, 79 (Fed. Cir. 2012)).

1. The Parties’ Arguments

Patent Owner contends that “[d]uring its prior litigation against [REDACTED] RPX Corp. (‘RPX’) approached Greenthread about negotiating a license on behalf of [REDACTED] and other companies,” [REDACTED] PO Resp. 32 (citing Ex. 2072 (Rao Declaration)). Patent Owner contends that it “never threatened litigation against either [REDACTED] or [REDACTED] in any way.” *Id.* (citing Ex. 2072). Patent Owner asserts that licenses taken without threat of litigation are especially probative of non-obviousness. PO Resp. 32 (citing *Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling USA, Inc.*, 699 F.3d 1340, 1353 (Fed. Cir. 2012); *Samsung Elec. Co. Ltd. v. Neonode Smartphone LLC*, IPR2021-00144, Paper 59 at 51 (PTAB Dec. 15, 2022)). Patent Owner contends [REDACTED] and [REDACTED] are sophisticated companies who frequently file IPR petitions, yet both paid for licenses covering just the single patent family at issue here. *Id.* at 33. Patent Owner further contends that as part of litigation settlements, at least five other large, sophisticated parties have taken licenses, with eight

major semiconductor companies now having paid more than [REDACTED] for licenses “which covered only one patent family.” *Id.* at 34.

Petitioner argues in its Reply that litigation-based licenses require a nexus to the merits of the claimed invention because parties often pay licenses to avoid litigation costs, and [REDACTED] licenses were made through RPX, which structures its arrangements to avoid litigation costs. Pet. Reply 23–24 (citing *Iron Grip Barbell Co. Inc. v. USA Sports, Inc.*, 392 F.3d 1317, 1324 (Fed. Cir. 2004); Exs. 1060, 1061).

Patent Owner argues in its Sur-Reply that “[t]here is zero doubt that there is a ‘legally and factually sufficient connection between the [licenses] and the patented invention,’” and “[e]ach license agreement covers a *single patent family* with nearly identical specifications, and the claimed feature of using a graded dopant *is* recited in the licenses.” PO Sur-Reply 25 (quoting *Quanergy Sys., Inc. v. Velodyne Lidar USA, Inc.*, 24 F.4th 1406, 1417 (Fed. Cir. 2022); citing Ex. 2078 ¶¶ 2, 3, pp. 19, 45). Patent Owner further argues that “[i]t is . . . undisputed that RPX *approached Greenthread* on behalf of [REDACTED]—two companies under no threat of litigation” and “Petitioner’s reliance on RPX’s marketing material is simply out of place, as it can point to zero evidence that [REDACTED] were motivated by ‘avoid[ing] litigation costs.’” *Id.* (citing Ex. 2078 ¶ 4; quoting Pet. Reply 23–24).

2. *Analysis of the Parties’ Arguments*

We find that there is a nexus between the objective indicia and the challenged claims based on the RPX license that includes Application No. 15/590,282, which issued as the ’842 patent in the listing of the patent family covered by the license. *See* Ex. 2072, 45 (Appendix B, Exhibit B);

Ancora, 140 F.4th at 1362. Patent Owner relies on the RPX license to [REDACTED] and asserts that its technique of “creating ‘a drift field to sweep these unwanted minority carriers from the active circuitry at the surface into the substrate’” is “part and parcel” with the RPX license. PO Resp. 33 (quoting Ex. 1001, 3:52–56). We have considered the RPX license to [REDACTED] and Patent Owner’s argument.

Even though Patent Owner has established a nexus between its licensing revenue and the challenged claims, such evidence does not outweigh the strong evidence of obviousness presented by Petitioner. As set forth above, Patent Owner asserts that the innovative and “novel technique” of the patent family is creating “a drift field to sweep these unwanted minority carriers from the active circuitry at the surface into the substrate.” PO Resp. 33 (quoting Ex. 1001, 3:52–56). For the reasons discussed below, Petitioner persuasively demonstrates that Kawagoe, Onoda, and the combination of Onoda and Nishizawa each respectively discloses such a drift field. Thus, the allegedly novel advancement of the ’842 patent is found in the prior art. *See Yita LLC v. MacNeil IP LLC*, 69 F.4th 1356, 1364 (Fed. Cir. 2023) (“But our case law makes clear that objective evidence of nonobviousness lacks a nexus if it exclusively relates to a feature that was known in the prior art—not necessarily well-known.” (internal quotations and citations omitted)).

Despite that the RPX license conveys a right to the challenged claims sufficient to support a nexus, we decline to give significant weight to the RPX license. We do not agree with Patent Owner that the RPX license is especially probative because [REDACTED] were under no apparent

threat of litigation. *See* PO Resp. 32–33. Although Patent Owner argues that the RPX license was not motivated by a threat of litigation, and that [REDACTED] and [REDACTED] frequently file IPR petitions (*id.* at 33), the weight of evidence does not support those arguments. RPX markets itself as a cost-saving service that spreads litigation cost across a large network of companies and “remove[s] patents from circulation before they become costly issues.” Ex. 1060, 1.

In view of this evidence, Patent Owner’s argument that [REDACTED] and [REDACTED] entered a license under no apparent threat of litigation is not persuasive because RPX is a risk mitigation service and, therefore, on this record, the license may reflect the value of avoiding the risk of litigation rather than the value of the challenged patent specifically. *Cf. Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling USA, Inc.*, 699 F.3d 1340, 1353 (Fed. Cir. 2012) (License found to be due to the merits of the claimed invention to support nonobviousness where royalties exceeding the cost of litigation reflected the value of the licensed technology); *Samsung Elec. Co. Ltd. v. Neonode Smartphone LLC*, IPR2021-00144, Paper 59 at 51 (PTAB Dec. 15, 2022) (License found to be due to an interest in “[the patent owner’s] technology exclusively” and not some “other economic reason that might discount . . . interest in exclusively licensing the technology.”).

Unlike in the *Samsung v. Neonode* case, the record before us does not provide sufficient evidence that the amount paid for the RPX license is due exclusively to the licensed technology rather than some other economic reason. In addition, unlike in the *Transocean* case, the record here includes no evidence of the contribution that [REDACTED] made towards the lumpsum licensing fee, relative to the contribution of [REDACTED] and/or any

other RPX member. The record is not sufficiently developed to determine whether the contribution amounts of [REDACTED] are significant compared to the potential cost of litigation. Ex. 2072 ¶ 6.

As to Patent Owner’s argument that the license evidences non-obviousness because “moving carriers ‘from the active circuitry at the surface’ is missing from the prior art” (PO Resp. 34), we disagree for the reasons discussed below. *See Tokai Corp. v. Easton Enters., Inc.*, 632 F.3d 1358, 1369 (Fed. Cir. 2011) (“If commercial success is due to an element in the prior art, no nexus exists.”); *Ormco Corp. v. Align Technology, Inc.*, 463 F.3d 1299, 1312 (Fed. Cir. 2006) (“[I]f the feature that creates the commercial success was known in the prior art, the success is not pertinent.”). In other words, even though Patent Owner has established a nexus between its licensing revenue and the challenged claims, we find the licenses are entitled to less weight than Petitioner’s strong evidence as to the obviousness of the features, which assertedly create the commercial success but plainly were known in the prior art.

Having determined the weight to be given to Patent Owner’s licenses, we turn to the evidence and argument regarding the remaining *Graham* factors in evaluating Petitioner’s obviousness contentions as to the challenged claims. Even if we were to give the RPX license significant weight, we determine that Petitioner’s showings of *prima facie* obviousness, particularly in view of the strength of the ground based on Kawagoe (a single reference obviousness ground), the strength of the ground based on Onoda (a single reference obviousness ground), and the strength of the ground based on Onoda and Nishizawa, discussed below, outweigh Patent Owner’s objective evidence of nonobviousness. *See Tokai Corp.*, 632

F.3d at 1371 (“A strong case of prima facie obviousness . . . cannot be overcome by a far weaker showing of objective indicia of nonobviousness.”).

E. Obviousness Based on Kawagoe

Petitioner contends that claims 1, 2, 4–9, and 12–18 would have been obvious in view of Kawagoe. Pet. 12–36.

1. Kawagoe

Kawagoe discloses a process for manufacturing a semiconductor integrated circuit device using an epitaxial wafer, i.e., a semiconductor wafer having a semiconductor single crystal epitaxial layer grown over a polished semiconductor substrate. Ex. 1007, 1:13–27, 2:31–35. According to Kawagoe, “[t]he epitaxial wafer is advantageous in that it is excellent in suppressing the soft errors and resisting to the latchup,” as well as “drastically reduc[ing] the defect density of the gate insulating film” of a semiconductor integrated device. *Id.* at 1:33–40.

Kawagoe discloses various “representative” processes, including processes in which the single crystal (epitaxial) layer contains an impurity of the same type and in the same concentration as the substrate body. Ex. 1007, 2:55–3:9. According to Kawagoe, the impurity concentration of the substrate body can be made higher than that of epitaxial layer “so that the resistance of the semiconductor substrate body can be relatively lowered to improve the resistance to the latchup.” *Id.* at 4:1–8. Kawagoe discloses a process for manufacturing a semiconductor integrated circuit device including a step of forming a semiconductor region (well) extending below the epitaxial layer and having an impurity concentration that decreases with increasing depth below the epitaxial layer. *Id.* at 3:10–25. According to Kawagoe, the well

can be used for forming a complementary Metal-Oxide-Semiconductor Field-Effect Transistor (“MOS.FET”) circuit. *Id.* at 3:32–38.

Kawagoe describes seven embodiments, including Embodiment 1 (Ex. 1007, 6:41–12:40, Figs. 1–8) and Embodiment 4 (*id.* at 14:46–19:64, Figs. 16–25). According to Embodiment 1, a semiconductor integrated circuit device includes semiconductor substrate body 2S, epitaxial layer 2E, and gettering layer 2G. *Id.* at 6:51–56, Fig. 1. Substrate body 2S and epitaxial layer 2E are doped with p-type impurity in equal concentrations. *Id.* at 6:60–7:3, 10:51–55, 11:12–16. Embodiment 1 includes n-channel MOS.FET (“nMOS”) 4N and p-channel MOS.FET (“pMOS”) 4P, the latter being formed in n-well 6, which is doped with n-type impurity and extends below the epitaxial layer. *Id.* at 8:46–52, 9:32–40, 11:18–24, 11:43–50, Figs. 1, 5, 7.

According to Embodiment 4, substrate body 2S and epitaxial layer 2E are doped with p-type impurity, and the impurity concentration of substrate body 2S is higher than that of epitaxial layer 2E “to improve the resistance to the latchup.” Ex. 1007, 14:64–15:6, 15:13–17, 16:16–21, 19:59–63, Fig. 17. Embodiment 4 includes p-well 6p formed with nMOS 4N and n-well 6n formed with pMOS 4P. *Id.* at 15:26–40, 17:40–18:35, Figs. 16, 21–23. In Embodiment 4, the impurity concentration in p-well 6p and n-well 6n decreases with increasing depth below the epitaxial layer. *Id.* at 15:62–16:15, 17:55–61, Fig. 17. Kawagoe discloses that the concentration gradient reduces soft errors by attracting carriers (electrons) to the substrate and preventing them from entering the p-well. *Id.* at 16:2–11.

Petitioner relies on Kawagoe Figure 17, reproduced below, which illustrates Embodiment 4 and its properties.

FIG. 17

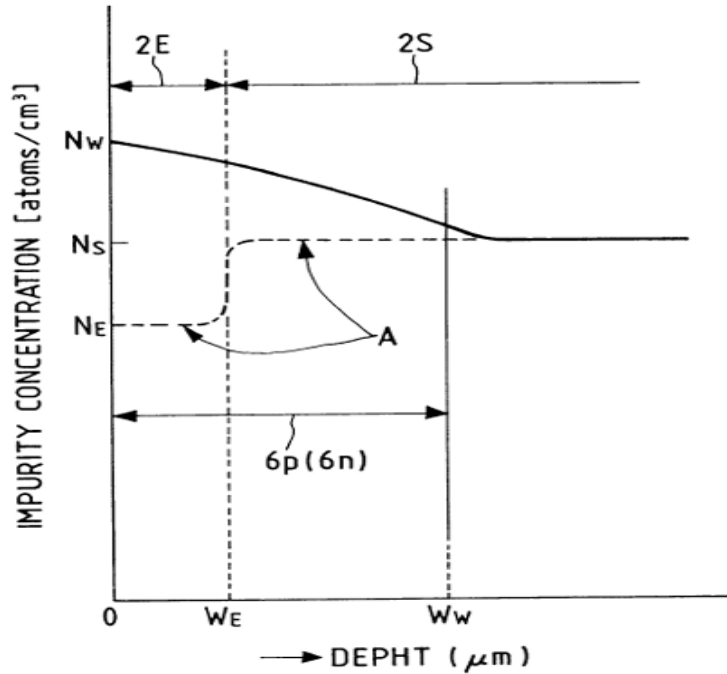


Figure 17 is a plot of impurity concentration as a function of depth in a semiconductor integrated circuit device, which shows “the p-well $6p$ and n-well $6n$ have their impurity concentrations gradually lowered in the depthwise direction from the principal surface (having an impurity concentration N_w) of the epitaxial layer $2E$.” Ex. 1007, 5:41–45, 15:62–16:40.

Petitioner also relies on Kawagoe Figure 23, reproduced below, which also illustrates Embodiment 4 and its properties.

FIG. 23

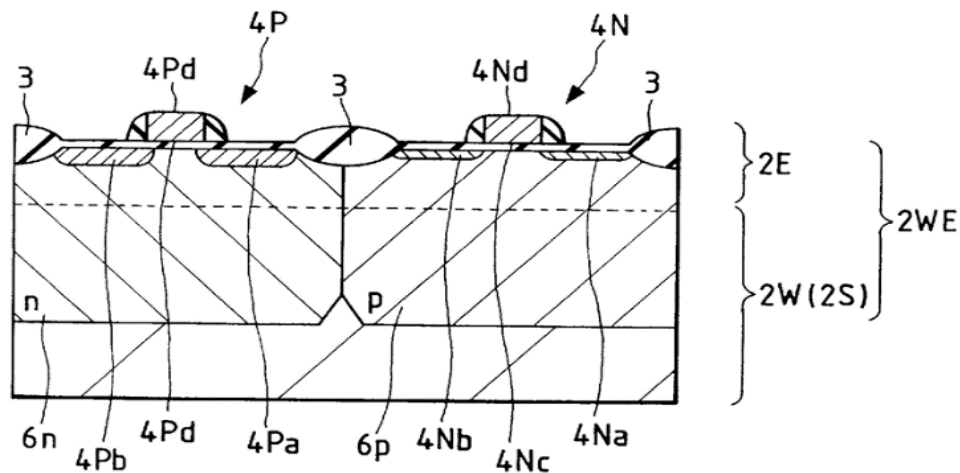


Figure 23 shows a step in a process for manufacturing a semiconductor integrated circuit device, including p-well 6p formed with nMOS 4N and n-well 6n formed with pMOS 4P. *Id.* at 6:1–4, 15:26–32, 18:3–35.

2. Petitioner’s Contentions for Independent Claim 1

Petitioner argues that Kawagoe would have taught or suggested the limitations of claim 1. Pet. 13–26.

Preamble: “[a] semiconductor device, comprising”

Without taking a position as to whether the preamble is limiting, Petitioner contends that “Kawagoe discloses a semiconductor device” and “teaches that the disclosed semiconductor integrated circuit devices (including MOSFET circuits and various VLSI circuits) can be used in various applications, including memory devices such as DRAM, SRAM, ROM, and semiconductor devices with logic circuits such as the so-called ‘microcomputer.’” Pet. 13 (citing Ex. 1007, 1:13–17, 24:21–31; Ex. 1003 ¶ 151).

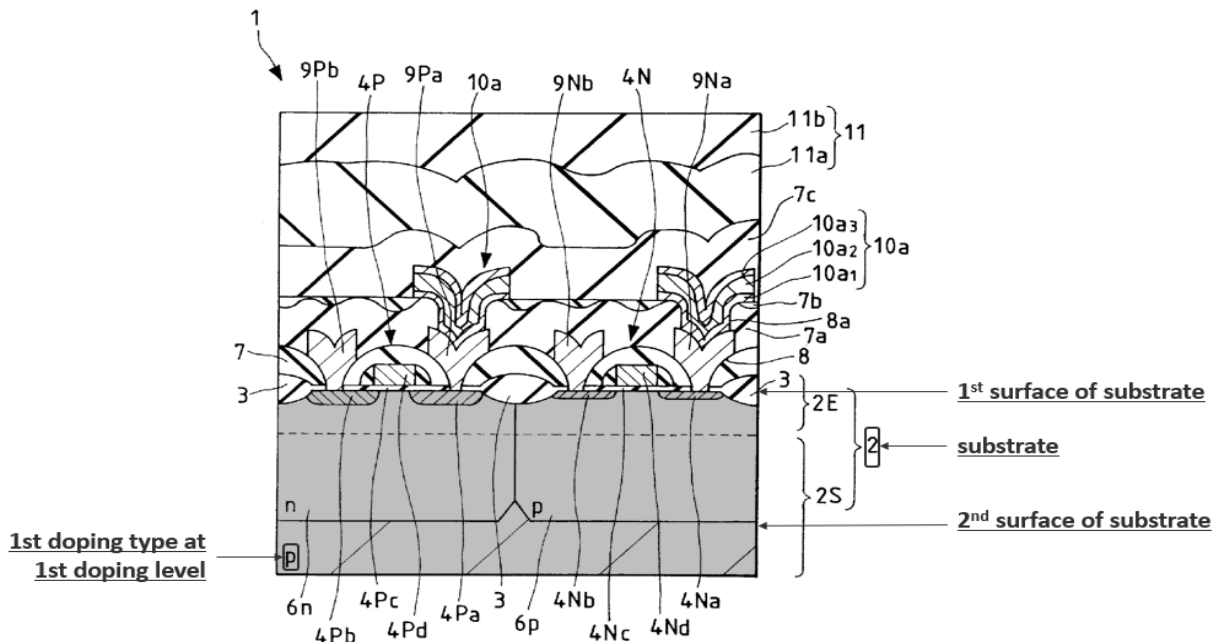
Patent Owner does not contest Petitioner’s evidence pertaining to claim 1’s preamble. Based on the complete record developed during trial, we determine that Petitioner demonstrates by a preponderance of evidence that Kawagoe teaches the subject matter of the preamble of claim 1. As such, we need not and do not determine whether the preamble of claim 1 is limiting.

[1.1] “a substrate of a first doping type at a first doping level having first and second surfaces”

According to Petitioner, “Kawagoe discloses a p-type substrate 2, *i.e.*, the claimed ‘a substrate of a first doping type at a first doping level.’”

Pet. 13. In Petitioner’s annotated version of Kawagoe’s Figure 16, reproduced below, “p-type substrate 2 include[es] a p-type Si single crystal substrate body 2S and a p-type Si single crystal epitaxial layer 2E.” *Id.* (citing Ex. 1007, 14:61–15:12, 15:11, 15:26).

FIG. 16



Petitioner’s annotated version of Kawagoe’s Figure 16 shows different surfaces of substrate 2. Pet. 14. According to Petitioner,

substrate 2 has various surfaces between different layers or components, and the claimed first and second surface of the substrate 2 are annotated below where the first surface is the top surface of epitaxial layer 2E of the substrate 2 and the second surface is the bottom surface of the N well 6n and the P well 6p.

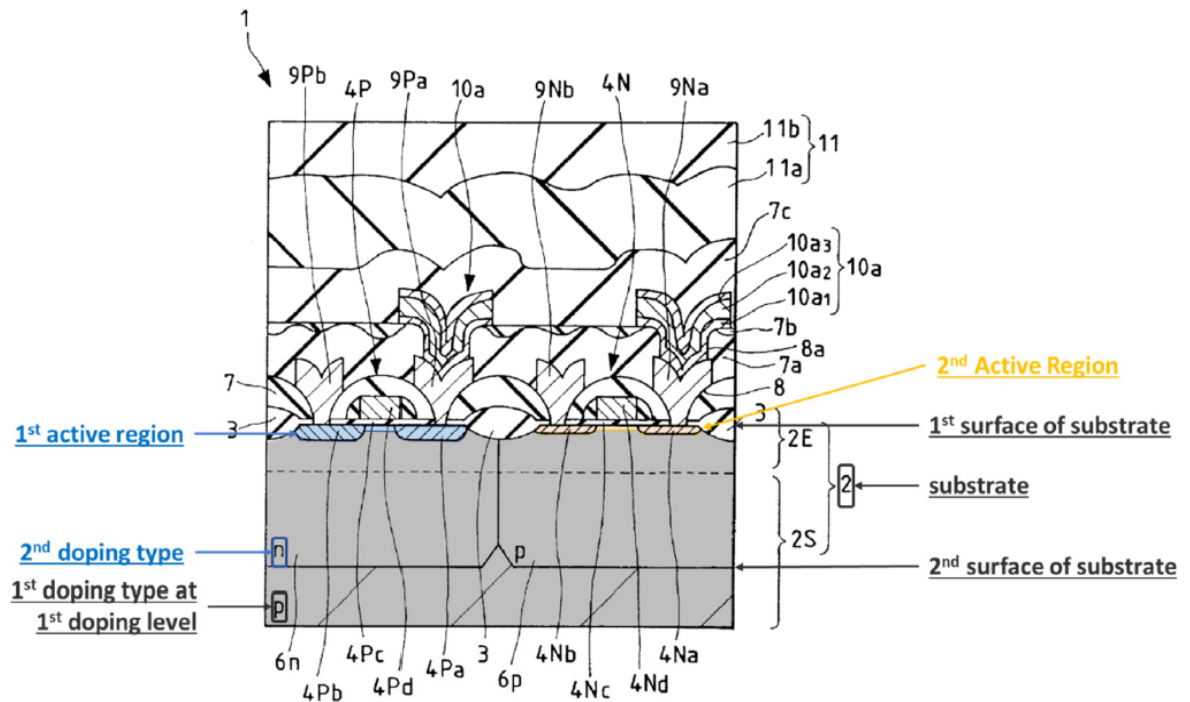
Id. at 13–14 (footnote omitted). Thus, Petitioner contends, “Kawagoe’s substrate 2 [] satisfies the claimed ‘a substrate of a first doping type at a first doping level having first and second surfaces.’” *Id.* at 14 (citing Ex. 1003 ¶ 153); *see id.* at 13 (citing Ex. 1003 ¶¶ 152–157).

Patent Owner does not contest Petitioner’s evidence pertaining to limitation [1.1]. Based on the complete record developed during trial, we determine that Petitioner establishes by a preponderance of the evidence that the cited portions of Kawagoe, supported by Dr. Campbell’s testimony, teach this limitation of claim 1.

[1.2] “a first active region disposed adjacent the first surface of the substrate with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed”

Pointing to another annotated version of Kawagoe’s Figure 16, reproduced below, Petitioner contends that “Kawagoe provides an n-well 6n that includes an active region (annotated blue, below), forming the source, drain, and channel of PMOS transistor 4P.” Pet. 16 (citing Ex. 1007, 9:41–54, 15:26–36).

FIG. 16



Petitioner’s annotated version of Kawagoe’s Figure 16 illustrates first and second active regions of substrate 2. According to Petitioner, “[t]he claimed ‘first active region’ is in the n-type region-well 6n that is opposite in conductivity to the first doping type of the substrate 2 (*i.e.*, p-type).” *Id.* at 16 (citing Ex. 1007, 14:61–15:12, 15:26–28, 15:30–43). Petitioner contends that:

A POSITA would have understood that the active region’s channel region depicted in Kawagoe’s FIG. 16 . . . would remain n-type after forming the source and drain, and the claimed ‘a first active region . . . with a second doping type opposite in conductivity to the first doping type’ is satisfied by the PMOS formed in the n-well.

Id. at 16–17 (citing Ex. 1003 ¶ 161) (footnote omitted).

Petitioner further contends that “a POSITA would understand that the above-annotated ‘active region’ comprises a source, channel region, and drain, that provides for conductivity and thusly is an active region.” Pet. 18. “The active region of a MOS transistor is known to be ‘[its] channel and [its] heavily doped source and drain regions.’” *Id.* (citing Ex. 1003 ¶ 162; Ex. 1008, 299). According to Petitioner,

[t]his is also confirmed by Patent Owner’s arguments, where when discussing the term “active region . . . within which transistors can be formed” it argued that “this term means exactly what it says: an active region (*i.e.*, a doped region at the surface of a semiconductor device) where a transistor can be formed.”

Id. (citing Ex. 1030, 31). Petitioner accordingly contends that “Kawagoe [] discloses the claimed ‘active region.’” *Id.*

Petitioner further contends that

a POSITA would have understood that ‘a first active region disposed adjacent the first surface of the substrate’ means the first active region is disposed vertically adjacent the first surface of the substrate because the first active region in which transistors can be formed is below the top surface of the substrate to include the source, the drain and the channel region of a transistor.

Id. at 18–19 (citing Ex. 1003 ¶¶ 163–164); *see id.* at 16 (citing Ex. 1003 ¶¶ 158–165).

Patent Owner does not contest Petitioner’s evidence pertaining to limitation [1.2]. Based on the complete record developed during trial, we determine that Petitioner establishes by a preponderance of the evidence that the cited portions of Kawagoe, supported by Dr. Campbell’s testimony, teach this limitation of claim 1.

[1.3] “a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed”

Petitioner contends that “Kawagoe’s FIG. 16 discloses a second active region . . . separate from, and adjacent to, the first active region.” Pet. 19 (citing Ex. 1007, 15:26–28). According to Petitioner, “[t]he p-well 6p is doped with a p-type impurity such as boron’ and ‘formed with the nMOS 4N.’” *Id.* (citing Ex. 1007, 15:28–30). Petitioner further contends “Kawagoe discloses that the semiconductor regions 4Na and 4Nb are regions for forming the source-drain regions of the nMOS 4N.” *Id.* (citing Ex. 1007, 8:55–9:6, 18:9–38).

Petitioner further contends

[a]s discussed above in Element [1.2], a POSITA would understand that the claimed second active region encompasses a source, drain, and channel region. This is depicted in Kawagoe’s FIG. 16 where the NMOS transistor, having the claimed “second active region,” is formed.

In the context of Element [1.3], a POSITA would have understood “a second active region separate from the first active region disposed adjacent to the first active region” to mean a lateral adjacency between the first and second active regions because the first and second active regions are regions “in which transistors can be formed.” Similarly, in Kawagoe, the first active region in the n-well 6n associated with the PMOS transistor 4P and the second active region in the p-well 6p associated with the NMOS transistor 4N are adjacent to each other based on a lateral adjacency.

Pet. 20 (citing Ex. 1003 ¶ 168).

Patent Owner does not contest Petitioner’s evidence pertaining to limitation [1.3]. Based on the complete record developed during trial, we determine that Petitioner establishes by a preponderance of the evidence that

the cited portions of Kawagoe, supported by Dr. Campbell's testimony, teach this limitation of claim 1.

[1.4] “transistors formed in at least one of the first active region or second active region”

Petitioner relies on its arguments for limitations [1.2] and [1.3] for teaching limitation [1.4]. Pet. 22 (citing Pet. §§ VII.A.1.c–d; Ex. 1003 ¶¶ 38–45, 168, 170).

Patent Owner does not contest Petitioner's evidence pertaining to limitation [1.4]. Based on the complete record developed during trial, we determine that Petitioner establishes by a preponderance of the evidence that the cited portions of Kawagoe, supported by Dr. Campbell's testimony, teach this limitation of claim 1.

[1.5] “at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first surface to the second surface of the substrate”

Petitioner contends that Kawagoe's “FIGS. 16 and 17 illustrate the claimed ‘at least a portion of at least one of the first and second active regions having at least one graded dopant concentration.’” Pet. 23. Petitioner further contends that

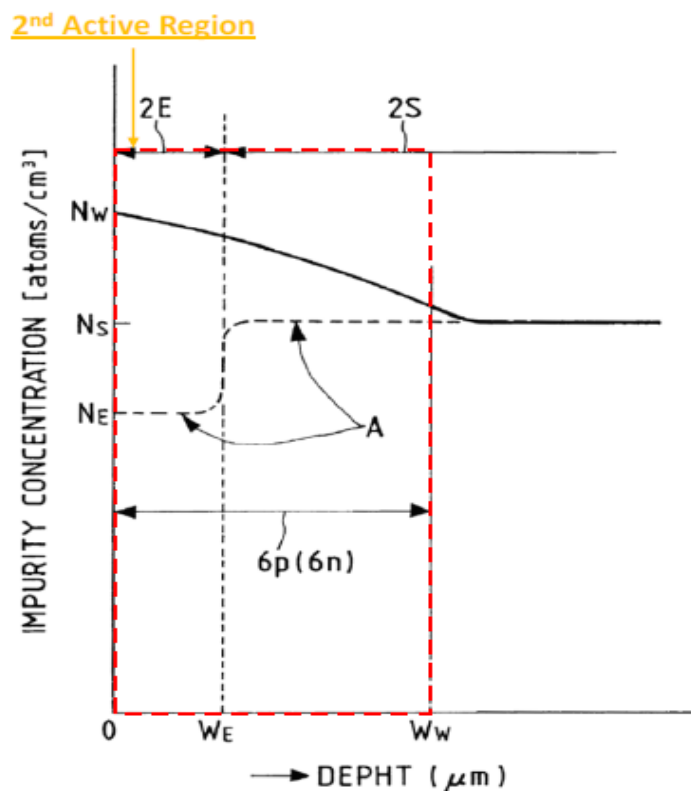
[Kawagoe's] FIG. 17 illustrates dopant concentration as a function of depth of the physical device depicted in FIG. 16. The first and second active regions (annotated in blue and tan) are at the first surface of the semiconductor device and have a graded dopant gradient so that carriers (*e.g.*, minority carriers, *i.e.*, electrons in the p-well 6p and holes in the n-well 6n, whose movement is annotated with the purple arrow) are attracted to the substrate to reduce errors.

Id. (citing Ex. 1007, 14:46–67, 15:62–16:15).

Petitioner further contends that, “[a]s can be seen from FIGS. 16 and 17, the ‘second active region’ at the top surface of the p-well 6p in the substrate is where the downward dopant gradient begins, and it levels off shortly after the well 6p (red-dashed annotation).” Pet 23 (footnote omitted). Pointing to its annotated version of Figure 17 of Kawagoe, reproduced below, Petitioner contends that

Kawagoe's downward graded dopant concentration for each of the p-well 6p and n-well 6n is present from the top surface to the bottom surface of each well to generate a drift electric field to move their respective minority carriers downward to the bottom surface of each well, which is the second surface of the substrate 2 in Kawagoe.

Id. at 25 (citing Ex. 1003 ¶¶ 173–178).



Petitioner's annotated version of Kawagoe's Figure 17 depicts dopant concentration at the second active region. Pet. 24. "Therefore," according to Petitioner "Kawagoe's downward graded dopant concentration meets the claimed 'to aid carrier movement from the first surface to the second surface of the substrate.'" *Id.* at 25.

Petitioner contends that

Kawagoe states that the impurity concentration of the p-well 6p is given such a gradient that it is gradually lowered in the depthwise direction from the surface of the epitaxial layer 2E, so that the influence to be caused by the carriers (or electrons) due to the α -ray is lowered . . . [Petitioner also contends that] the electrons produced by the α -ray are attracted to the substrate body 2S by that concentration gradient and prevented from entering the p-well 6p so that the soft errors can be reduced in case the MIS memory of the DRAM or the like is formed in the p-well 6p.

Pet. 25–26 (citing Ex. 1007, 16:2–11). Petitioner further contends that "Kawagoe's graded concentration at the active regions (and into the wells) thusly meets the claimed 'to aid carrier movement from the first surface to the second surface of the substrate.'" *Id.* at 26.

Petitioner also contends that

[t]o the extent that the claimed second surface of the substrate in Element [1.5] is construed to be the outer bottom surface of the body substrate 2S in Kawagoe as described in Element [1.1], Kawagoe's disclosure nonetheless renders obvious Element [1.5] because the downward graded dopant concentration in the first or second active region causes the minority carriers to move downward in the well region towards the bottom surface of the body substrate 2S of the substrate 2. This understanding is consistent with Patent Owner's court-adopted claim construction

arguments that the limitation only requires that the carriers be aided downward and not reach the end of the substrate.

Pet. 26 (citing Ex. 1003 ¶ 179; Ex. 1049, 25; Ex. 1050, 13).

Patent Owner disputes Petitioner's evidence pertaining to limitation [1.5]. We resolve the dispute about this limitation in our analysis below.

3. *Patent Owner's Arguments*

Patent Owner disputes Petitioner's showing with respect to Kawagoe based on the following contentions relating to limitation [1.5], which we set forth below. *See generally* PO Resp.; PO Sur-Reply.

a) *Patent Owner's Contentions that Petitioner's Challenge does not Calculate Magnitude of Slope of Graded Dopant Concentration*

Patent Owner contends that Petitioner's challenge is based on inherency and that, as such, "[t]he 'probability or possibility' that a dopant gradient aids carrier movement 'is insufficient.'" PO Resp. 2 (citing *In re Robertson*, 169 F.3d 743, 745 (Fed. Cir. 1999)). According to Patent Owner, "[t]he prior art 'must necessarily include the unstated limitation.'" *Id.* at 2–3 (citing *Transclean Corp. v. Bridgewood Servs., Inc.*, 290 F.3d 1364, 1373 (Fed. Cir. 2002)); *see id.* at 17 (citing *Phillips*, 415 F.3d at 1314). Patent Owner contends that "Petitioner's references do not teach the 'aid carrier movement' claim limitations" and that, "[t]herefore, to locate 'aid carrier movement' in the prior art, the Petition assumes that *any* 'graded dopant concentration' will 'aid carrier movement.'" *Id.* at 10.

Patent Owner contends that the specification describes that "the slope of the dopant concentration is a relevant parameter for determining whether a concentration gradient will aid carrier movement." PO Resp. 14–15

(quoting Ex. 2061, 2:66–3:15 (“The gradient can be linear, quasi linear, exponential or complimentary error function.”)).

With regard to related litigations, Patent Owner contends that “[n]ot one but two District Courts have previously agreed with Greenthread that not *all* doping gradients aid carrier movement.” PO Resp. 17. According to Patent Owner, “[t]he Western District of Texas unequivocally stated, ‘a graded concentration . . . that is [not “sufficiently graded”] will not aid in the movement of minority carriers[.]’” *Id.* (alterations by Patent Owner) (citing Ex. 2074¹¹, 39–40). “And the Eastern District of Texas understood that direction alone does not determine whether a gradient aids carrier movement—the **magnitude** of the gradient must also be considered.” *Id.* at 17–18 (citing Ex. 2075¹², 15 (Patent Owner arguing that EDTX Markman Order “explain[s] that ‘the slope [of the gradient] has both a direction and a magnitude and [d]efendant [incorrectly] suggests that the direction of the drift electric field depends solely on **the direction** of the slope of the graded concentration’” (alterations and emphasis by Patent Owner))).

Patent Owner also argues that

Petitioner’s construction—that actual movement is not required—does render the claimed limitation “superfluous.” This is like arguing that a person can “aid movement” by pushing on a parked car. Even Petitioner’s own expert understood “aiding carrier movement” to refer to “sweeping carriers from the active circuitry at the surface into the substrate.” “Sweeping” the carriers means “moving” the carriers, and to argue otherwise is contrary to the surrounding claim language and the patent’s specification.

¹¹ Exhibit 2074, “WDTX Markman Order.”

¹² Exhibit 2075, “EDTX Markman Order.”

PO Sur-Reply 13–14 (quoting Pet. Reply 4; citing Ex. 1055, 67:25–68:19; quoting Ex. 1003 ¶¶ 26, 46 (cleaned up by Patent Owner)). According to Patent Owner, “[t]o improve performance of the claimed transistor, the minority carriers must not only *move*, but they must *move in the correct direction, from* the ‘first surface’ to deeper in the substrate.” *Id.* at 14; *see id.* (citing *Sequoia Tech., LLC v. Dell, Incl.*, 66 F.4th 1317, 1326 (Fed. Cir. 2023); *KEYnetik, Inc. v. Samsung Elecs. Co., Ltd.*, 837 Fed. Appx.786, 792 (Fed. Cir. 2020)).

b) Patent Owner’s Contentions that Petitioner’s Challenge does not Account for Additional Forces Acting on a Carrier

Patent Owner contends that “Petitioner’s assumption that the gradients in their prior art references would aid carrier movement fails, because the Petition fails to analyze whether the specific gradients at issue in the context of the disclosed devices would suffice to overcome the other forces that are present.” PO Resp. 15–16. Patent Owner argues that “if the forces acting on a carrier—i.e. the force exerted by a gradient and any other forces—cancel each other out, the carriers do not move at all.” *Id.* at 17.

Patent Owner also argues that,

[d]uring prosecution, the examiner likewise said that in “a complex electronic device, movement of minority carriers is affected by multiple forces and fields” and that a “drift field may attempt to apply a force on all minority carriers in a specific direction” but that “without knowing other parameters of the device” one cannot say whether the field would aid carrier movement.

PO Resp. 15 (quoting Ex. 1002, 270).

According to Patent Owner, “Petitioner’s expert admitted in his report that a graded concentration of dopants does not inherently aid minority

carrier movement” and “testified that ‘[t]he electric field [from a gradient] will provide a force’ but ‘[t]here may be other forces acting upon the carriers, and you have to add all of the forces.” PO Resp. 10–11 (citing Ex. 1003 ¶ 32 (“an electric field that is properly constructed will push the minority carriers away from the surface.” (emphasis and alterations by Patent Owner)); quoting Ex. 2085, 42:12–17; citing Ex. 2085, 95:14–17, 154:15–18). Patent Owner contends that “Dr. Campbell specifically identified other forces that need to be considered when determining the effect of a doping gradient,” including “temperature, capacitance effects at the PN junction, and imperfections in the silicon crystal.” *Id.* at 11 (citing Ex. 2085, 34:15–36:19, 39:8–12).

“With regards to PN junction capacitance,” Patent Owner contends that “Dr. Campbell testified that ‘[i]t creates a fairly substantial electric field in the depletion region . . . near the junction,’ which he said is in addition to the field created by the dopant gradient.” PO Resp. 12 (citing Ex. 2058, 35:22–36:4; Ex. 2057 ¶ 60). Patent Owner further contends that “Petitioner’s representations to the Office also confirm[] that capacitance effects must be considered to determine the effect of a graded dopant profile.” *Id.* (citing Ex. 2030 (U.S. Patent No. 8,704,292), 7:4–7 (“a graded doping profile, in combination with the capacitive depletion effect . . . , may provide a substantially uniform electric field within the drift region.”)). According to Patent Owner, however, “the Petition and Dr. Campbell’s report do not discuss the PN junctions in the prior art devices.” *Id.*

Patent Owner argues:

Petitioner’s assumption that the gradients in their prior art references would aid carrier movement fails, because the Petition

fails to analyze whether the specific gradients at issue in the context of the disclosed devices would suffice to overcome the other forces that are present. Since Petitioner does not measure or account for these forces, and does not compare them to the magnitude of the force exerted by the gradients in the alleged prior art, they fail to establish that the disclosed gradients would “aid carrier movement.”

PO Resp. 15–16 (citing Ex. 2057 ¶¶ 54–58, 60, 64). Patent Owner points out that, “[d]uring prosecution, the examiner likewise said that in ‘a complex electronic device, movement of minority carriers is affected by multiple forces and fields’ and that a ‘drift field may attempt to apply a force on all minority carriers in a specific direction’ but that ‘without knowing other parameters of the device’ one cannot say whether the field would aid carrier movement.” *Id.* at 15 (citing Ex. 1002, Ex. 2080).

c) *Patent Owner’s Contentions that Prosecution History Supports Greenthread*

According to Patent Owner, “Petitioner says that Greenthread argued in prosecution that the ‘graded dopant concentration itself creates a “built-in” electrical field that forces the movement of carriers into a particular direction.” PO Resp. 18 (citing Pet. 52). Patent Owner argues “[t]he point of the sentence Greenthread actually wrote is that a ‘graded dopant concentration’ must move carriers *to meet the claim limitation*, not that any and every graded dopant concentration must move carriers” and “Greenthread was emphasizing that ‘aid carrier movement’ is a separate claim element from ‘graded dopant concentration’—the exact opposite of what Petitioner asserts.” *Id.* at 18–19. Patent Owner contends that “[t]he prosecution history cannot overcome the clear claim language distinguishing

the ‘graded’ and ‘aided’ terms.” *Id.* at 18. Patent Owner further contends, “[i]n context, [it] said:

Defendants assert that the specification does not provide guidance on how to assess or measure carrier movement. This is not true. The claims and the specification make clear that the electric field must move the carriers in a particular direction (from the surface layer to the substrate). Whether the carrier movement has a particular speed or acceleration is beyond the scope of the claim, as long as it meets the other limitations of the claim.”

Id. at 19 (quoting Ex. 1030 (Patent Owner’s Responsive Claim Construction Brief), 38).

In response to Petitioner’s claim “that Greenthread represented during prosecution that downward-sloping graded-dopant concentrations were known and created an inherent built-in unidirectional electric field” (PO Resp. 19 (quoting Pet. 9) (internal quotation marks omitted)), Patent Owner contends that, during prosecution, it “added that the movement of carriers ‘[d]epend[s] on the particular slope of the graded concentration of dopant[s].’” *Id.* (citing Ex. 1002, 289).

According to Patent Owner, “[t]hose additional claim limitations were, as Greenthread said, an ‘additional parameter for ensuring that all minority carriers are moved in one direction.’” PO Resp. 19 (quoting Ex. 1002, 290). Patent Owner argues “[t]he fact that an ‘additional parameter’ besides the graded dopants is necessary to ‘ensur[e] that all minority carriers are moved’ shows that Greenthread was not asserting that ‘graded’ entails ‘aided.’” *Id.* at 19–20.

d) *Patent Owner's Contentions that Kawagoe Teaches Inhibiting, not Aiding, Carrier Movement*

Patent Owner contends that “Kawagoe teaches using a graded slope to *impede* carrier movement” and “proves that graded dopant concentrations don’t *always* aid carrier movement, as Petitioner claims, because sometimes the ‘concentration gradient’ can ‘prevent’ carrier movement.” PO Resp. 16 (citing Ex. 2057 ¶¶ 62–68). According to Patent Owner,

Kawagoe is concerned with naturally occurring α -rays striking a semiconductor device and generating free electrons in the substrate. These free electrons can disrupt the operation of the device during a “single event upset” (“SEU”). Kawagoe teaches a “concentration gradient” to “*prevent* [these SEU-generated carriers] from entering the p-well.”

Id. (quoting Ex. 1007, 16:7–11).

e) *Patent Owner's Contentions About Whether There are Carriers in Kawagoe's Active Region*

Patent Owner argues that “[t]he carriers that Kawagoe describes are not in the ‘active region.’” PO Resp. 21. According to Patent Owner, “[e]very challenged independent claim requires “*active regions* having at least one graded dopant concentration to aid carrier movement,” and “Kawagoe does not teach that its gradient would have any effect on carriers in the ‘active region.’” PO Resp. 21. According to Patent Owner, Kawagoe states:

Specifically, the electrons produced by the α -ray are attracted to the substrate body 2S by that concentration gradient and *prevented from entering the p-well 6p* so that the soft errors can be reduced in case the MIS memory of the DRAM or the like is formed in the p-well 6p.

Id. (quoting Ex. 1007, 16:7–11) (highlighting omitted). Patent Owner contends:

Kawagoe does not address carriers in the “active region,” and does not “aid carrier movement *from the [first and second active regions | first or second active region | surface]*” because Kawagoe’s carriers are nowhere near what Petitioner identifies as the “surface” or first/second “active regions” and are in fact “*prevented from entering the p-well 6p*” which stands between them and the “active regions.”

Id. at 22 (citing Ex. 2057 ¶ 62). Patent Owner contends that “[s]ince Kawagoe teaches inhibiting carrier movement, it does not teach aiding carrier movement.” *Id.* (citing Ex. 2057 ¶¶ 61–68). According to Patent Owner, “Dr. Campbell confirmed that Kawagoe’s teaching is about preventing carriers at the bottom from moving up, not about moving carriers at the top down.” *Id.* at 23 (citing Ex. 2057 ¶¶ 44–68).

Patent Owner also argues that “Petitioner’s understanding of Kawagoe’s disclosure regarding electrons generated by alpha-rays is incorrect.” PO Resp. 23 (citing Ex. 2057 ¶¶ 44–68). “As explained by Dr. Glew—who has experience working with alpha-rays/alpha particles—a POSITA would have understood when Kawagoe mentions ‘electrons produced by the α -ray’, Kawagoe is *not* describing electrons near the surface.” *Id.* (citing Ex. 2057 ¶¶ 61–68; Ex. 1007, 16:7–11).

Patent Owner further argues that “[t]he Petition does not include any obviousness arguments or cite Dr. Campbell for any obviousness rationale/evidence to support modifying Kawagoe to influence carriers in the surface or active region.” PO Resp. 24 (citing Pet. 23–26).

4. *Petitioner's Reply Arguments*

Petitioner responds to Patent Owner's arguments. *See generally* Pet. Reply.

a) *Petitioner's Reply to Patent Owner's Contentions that Petitioner's Challenge does not Calculate Magnitude of Slope of Graded Dopant Concentration*

Petitioner contends that the district court orders cited by Patent Owner “involved different disputes and held that the claimed ‘graded concentration’ merely requires a relative slope.” Pet. Reply 4 (citing PO Resp. 17–18).

With respect to the WDTX Markman Order, Petitioner contends that

[t]he W.D. Texas order addressed the indefiniteness of a “graded concentration.” The parties disputed whether “graded” had any meaning; [Patent Owner] successfully argued that the specification sufficiently depicted “graded” because it depicted a downward slope.

Id. (citing Ex. 2074, 32, 36, 38–39, 41). With respect to the EDTX Markman Order, Petitioner contends that

[t]he E.D. Texas order construed the “single drift layer” and its “unidirectional electric field.” The court addressed whether the construction required a non-varying, constant slope and held that “the slope of the graded concentration need not be solely decreasing or solely increasing to yield the recited ‘unidirectional electric drift field.’”

Id. at 4–5 (citing Ex. 2075, 10, 11).

Petitioner contends that Patent Owner “directly contradicts arguments it made during prosecution of the ’195 Patent to overcome § 112

rejections.”¹³ Pet. Reply 5 (citing IPR2023-01243, Paper 82 at 35).

According to Petitioner, during prosecution of the ’195 patent, Applicant stated that

“a unidirectional drift (electric) field *necessarily affects all* the present minority carriers in the same way—*moving all* minority carriers in the same direction...” Applicant argued that the USPTO had failed to recognize that “the *graded dopant concentration itself* creates a ‘built-in’ electrical field that *forces the movement* of carriers into a particular direction.” Applicant went further—“without conceding Applicant’s position on this issue,” it amended the claims by deleting “drawing all minority carriers” and substituting “aid the movement of minority carriers,” and argued that a graded dopant concentration inherently aids movement. Applicant unequivocally committed itself to the position that a downward dopant gradient, by itself, “aid[s] the movement of minority carriers.”

Id. at 5–6 (quoting Ex. 1002, 286, 289–90) (emphases added by Petitioner).

Petitioner also contends that

[Patent Owner] contradicts its argument in district court that “aid the movement” is “a simple term” that is definite because “[e]lectric drift fields are a well-known phenomenon that cause carriers to move, and a POSITA would have readily recognized that when a ‘static unidirectional electric drift field’ is present that [sic] it aids the movement of minority carriers.” [Patent Owner] continued: “[w]hile the claims require that the graded dopants create an electric field that aids movement of the carriers, *they do not require* a specific range of doping, a particular doping field, or *a particular result*, and this information is not necessary to understand the scope of [Inventor’s] invention.” Those statements directly contradict

¹³ Petitioner refers to U.S. Patent No. 8,421,195, which is identified on the face of the ’842 patent as originating from a grandparent application. Ex. 1001, code (60).

[Patent Owner]’s arguments that a slope’s magnitude, and the combined force effect, must be calculated to reach the limitation.

Id. at 7 (quoting Ex. 1030, 25, 26, 28) (alterations and emphases by Petitioner). According to Petitioner, “to convince the USPTO to issue its claims, and to convince the district court that ‘aid the movement’ is sufficiently definite, PO argued that a downward dopant gradient—in itself—aids carrier movement and that a POSITA would understand as much,” and accordingly, “PO is now precluded from disavowing those statements.” *Id.*

b) *Petitioner’s Reply to Patent Owner’s Contentions that Petitioner’s Challenge does not Account for Additional Forces*

Petitioner contends that the challenged claims “describe a device’s *structure*, not a method and active performance.” Pet. Reply 3–4 (citing *ParkerVision, Inc. v. Qualcomm Inc.*, 903 F.3d 1354, 1361 (Fed. Cir. 2018)). Petitioner argues that the claims “merely require that the claimed ‘graded dopant concentration’ ‘aid carrier movement’—*not* that it generate a field to overcome all other theoretical forces (none of which are identified the specification, prosecution history, or the cited prior art) that may exist within a theoretical device.” *Id.* at 4 (citing *ParkerVision*, 903 F.3d at 1361).

Petitioner contends that even though Patent Owner argued during the district court litigation, to avoid indefiniteness, that “the graded dopant concentration is like a wheelchair ramp, and ‘nobody would dispute that a wheelchair ramp “aids the movement” of someone in a wheelchair,’” Patent Owner now “improperly seeks to concoct and apply a rigid test requiring all conceivable, hypothetical forces be calculated to reach obviousness.” Pet. Reply 10–11 (quoting Ex. 1030, 25; citing *id.* at 27–28 (“To use another

example, if a claim recites: a wheelchair ramp to aid movement of a wheel chair from a first level to a ground level. There is no requirement that the claim specify the length or slope of the ramp as long as it allows the wheelchair user to get to ground level. Again the same is true here. When the claims specify what is providing the movement, and the direction of the movement, nothing more is required.”); *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 403, (2007)).

Petitioner contends that Patent Owner’s “listing of other supposed ‘forces’ does nothing to counteract the dopant gradient’s drift field.” Pet. Reply 14 (citing PO Resp. 11–12). Petitioner contends that “[e]xcept for the P-N junction capacitance, [Patent Owner]’s purported ‘forces’ are not forces at all.” *Id.* Petitioner contends that while “the force introduced by the P-N junction capacitance . . . —theoretically—could affect the direction of carrier movement,” “the ’842 Patent and prosecution history of it says **nothing** about such capacitance, much less (1) attributes any significance to it, (2) suggests that it might counteract the drift field created by the dopant gradient, or (3) claims the capacitance as a problematic force.” *Id.* at 14–15. “Moreover,” Petitioner argues, “the field effect from the P-N junctions requires an applied voltage for electrons to flow, which the claims do not require,” while “[t]he graded dopant concentration is **static**—always present regardless of the device’s power state.” *Id.* at 15 (citing Ex. 2058, 35:10–17; Ex. 1059, 18–20).

c) Petitioner’s Reply to Patent Owner’s Contentions that Prosecution History Supports Greenthread

Petitioner contends that Patent Owner “repeatedly misrepresents the prosecution history.” Pet. Reply 8. According to Petitioner, Patent Owner

“wrongly states the Examiner argued that “without knowing other parameters of the device” one cannot say whether the field would aid carrier movement.”” *Id.* (quoting PO Resp. 15). Petitioner further contends that

In actuality, the cited rejection did not address the “aid the movement” limitation which was added *in response to* the cited rejection. (rejection for “drawing all”).) *After* this rejection, Applicant removed “drawing all” and added “aid the movement of” to the claims. Applicant argued that the drift field affects all carriers and the Examiner had not properly recognized that “the graded dopant concentration itself creates a ‘built-in’ electric field that forces the movement of carriers.” The claims were subsequently allowed.

Id. (citing Ex. 1002, 270, 286, 289, 341).

Petitioner also asserts that Patent Owner “falsely claims that, during prosecution, it argued that the graded dopant concentration must move carriers and emphasized that ‘aid the movement of minority carriers’ is a separate element from the graded concentration of dopants.” *Id.* (citing PO Resp. 18–19). According to Petitioner, “PO’s alleged support does not come from the prosecution history,” rather “it cites a section of its claim construction brief—that did not deal with the prosecution history—against Intel.” *Id.* (citing PO Resp. 18–19 (citing Ex. 1030, 29)).

Petitioner further contends that Patent Owner “falsely claims Applicant emphasized the slope’s magnitude during prosecution.” Pet. Reply 9 (citing PO Resp. 19–20).

In actuality, Applicant emphasized the slope’s *direction*, not its *magnitude*:

“a unidirectional drift (electric) field necessarily affects all the present minority carriers in the same way - ***moving all minority carriers in the same***

direction because of the unidirectional drift due to the existence of the electric field... ***Depending on the particular slope*** of the graded concentration of dopant, all minority carriers ***are either swept ‘down’*** (from the surface layer to the substrate) ***or ‘up’*** (from the substrate to the surface layer).”

Id. (quoting Ex. 1002, 289) (emphases by Petitioner).

Petitioner further contends that

PO falsely claims Applicant argued in prosecution that “aid the movement” was an “additional parameter” beyond the dopant gradient. (POR, 19-20.) In actuality, Applicant explicitly stated that the graded dopant concentration inherently creates the field that aids movement:

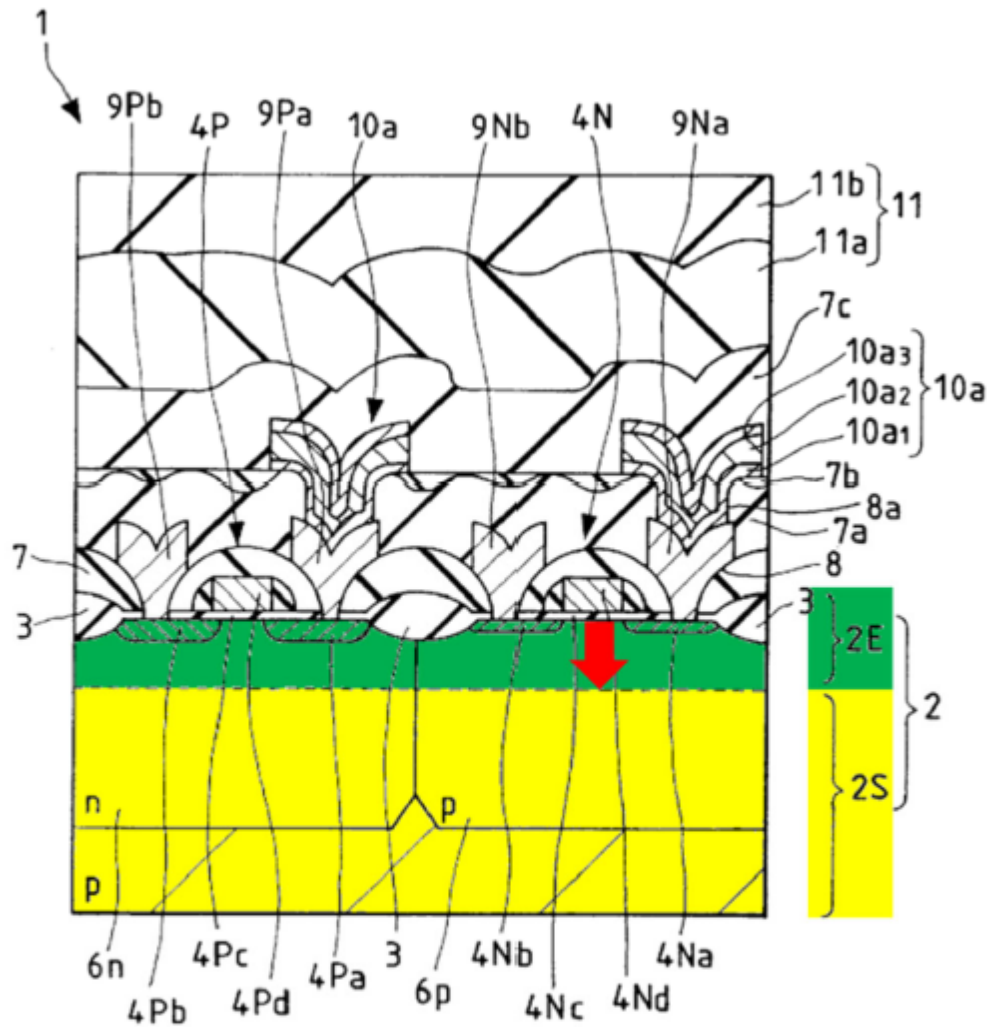
“the graded dopant concentration itself creates a ‘built-in’ electrical field that forces the movement of carriers into a particular direction ... [and] ***this inherent ‘built-in’ unidirectional electric field is the additional parameter*** for ensuring that all minority carriers are being moved in one direction ***and which parameter the Office Action deemed to be missing from the disclosure.***”

Pet. Reply 9 (quoted Ex. 1002, 289–90) (bold emphasis by Petitioner).

d) *Petitioner’s Reply to Patent Owner’s Contentions that Kawagoe Teaches Inhibiting, not Aiding, Carrier Movement*

Petitioner contends that Patent Owner’s “argument that Kawagoe solely ‘*inhibits* carrier movement’ contradicts its literal text.” Pet. Reply 16 (citing PO Resp. 16). Petitioner argues that “Kawagoe contains literal teachings that ‘electrons produced by the α -ray are ***attracted*** to the substrate body 2S’ and “[t]his is enough to render obvious ‘aid the movement.’” *Id.* at 17 (quoting Ex. 1007, 16:7–9 (emphasis added by Petitioner); citing Ex. 1055, 122:1–123:7). Pointing to its annotated version of Kawagoe’s

Figure 16, reproduced below, Petitioner contends “Kawagoe teaches: ‘electrons produced by the α -rays will be attracted to the substrate body 2S,’” (highlighted yellow in Figure 16, below), “which means that that they exist outside the substrate body 2S (*i.e.*, epitaxial layer 2E (green)) to be attracted to it (red arrow).” *Id.* at 15–16 (quoting Ex. 1007, 16:7–9).



Petitioner’s annotated version of Kawagoe’s Figure 16 depicts the direction of electron movement. Pet. Reply 16. According to Petitioner, Kawagoe “states that its objective is to reduce the influence of α -rays by including a graded dopant concentration ‘from the surface of the epitaxial layer 2E, so

that the influence to be caused by the carriers (or electrons) due to the α -ray is lowered.” *Id.* (citing Ex. 1007, 16:2–7; Ex. 1054 ¶ 12).

e) *Petitioner’s Reply to Patent Owner’s Contentions Whether There are Carriers in Kawagoe’s Active Region*

Petitioner contends Patent Owner’s “argument that Kawagoe excludes α -rays generating electrons near the surface is wrong.” Pet. Reply 15. According to Petitioner, “Kawagoe teaches: ‘electrons produced by the α -ray are attracted to the substrate body 2S.’” *Id.* (citing Ex. 1007, 16:7–9). According to Petitioner, Patent Owner’s “argument is also based on the faulty premise that α -rays will not hit Kawagoe’s p-well 6p to generate electrons. Nothing in Kawagoe (or other prior art) supports this extreme position.” *Id.* at 16.

5. *Analysis of the Parties’ Arguments*

We have considered the cited evidence, including expert testimony, and the parties’ arguments pertaining to the limitations of claim 1 that are in dispute. Below, we set forth our findings and conclusions as to those disputed issues.

Analysis Concerning Calculating Magnitude of Slope

With regard to the parties’ arguments concerning the “at least one graded dopant concentration to aid carrier movement” limitation, we briefly summarize the prosecution of U.S. Patent Application No. 11/622,496, the application leading to the ’195 patent. During prosecution, the Examiner rejected claims under the pre-AIA version of 35 U.S.C. § 112, first paragraph and found that “movement of minority carriers is affected by multiple forces and fields” and that “it does not appear that simply the presence of ‘a unidirectional drift field’ in itself can achieve ‘drawing all

minority carriers from said surface layer to said substrate.” Ex. 1002, 269–270, *see id.* at 289. The Applicant responded with following argument:

[A] unidirectional drift (electric) field necessarily affects all the present minority carriers in the same way - moving all minority carriers in the same direction because of the unidirectional drift due to the existence of the electric field. *See* “Physics and Technology of Semiconductor Devices,” A.S. Grove, pp. 224–225, John Wiley and Sons, Inc., New York, 1st Edition 1967 (“This same electric field will then be of such direction as to aid the motion of injected holes. Thus the injected minority carriers will now move not only by diffusion but also by drift due to the existence of this electric field.”). Depending on the particular slope of the graded concentration of dopant, all minority carriers are either swept “down” (from the surface layer to the substrate) or “up” (from the substrate to the surface layer). *See* Applicant’s Figs. 5(b) and 5(c).

Id. Patent Owner further argued that the Examiner’s argument that the simple presence of a “graded dopant concentration” “does not appear to ensure (without knowing other parameters of the device) that it will draw ‘all’ minority carriers”

appears to not consider that the graded dopant concentration itself creates a “built-in” electrical field that forces the movement of carriers into a particular direction, whereby the “direction” of the electrical field and the resulting direction of the carrier movement depends *solely* on the slope of the graded concentration of dopant. With regard to the existence of a “built-in” electric field created by a graded dopant density, . . . *this inherent “built-in” unidirectional electric field is the additional parameter for ensuring that all minority carriers are being moved in one direction* and which parameter the Office Action deemed to be missing from the disclosure.

Id. at 289–290 (emphases added). Also, “without conceding [its] position on this issue,” Patent Owner amended the claims to no longer require “drawing

all minority carriers,” and instead, requiring that the claimed “unidirectional drift field” created by the “graded concentration of dopants” “aid the movement of minority carriers.”¹⁴ *Id.* at 290.

We determine that the statements made by Patent Owner during prosecution of the ’195 patent were clear, unambiguous, and indicate that one of ordinary skill in the art need not know whether there are other “forces and fields” in an electronic device, as the mere presence of a graded dopant concentration creating a “unidirectional drift field,” facing in the appropriate direction, will “aid the movement of minority carriers from” the surface layer to the substrate. Ex. 1002, 270, 289–290. The public was entitled to rely on these clear and unambiguous statements when considering the scope of the challenged claims. *Hockerson-Halberstadt, Inc. v. Avia Group Int’l, Inc.*, 222 F.3d 951, 957 (Fed. Cir. 2000) (“The prosecution history constitutes a public record of the patentee’s representations concerning the scope and meaning of the claims, and competitors are entitled to rely on those representation when ascertaining the degree of lawful conduct, such as designing around the claim invention.”).

Based on the complete record developed during trial, Patent Owner’s statements during prosecution of the ’195 patent, along with the specification of the ’195 patent, support a determination that a graded dopant

¹⁴ The examined claims of the ’195 patent application generally recited “a unidirectional drift field drawing all minority carriers from said surface layer to said substrate.” Ex. 1002, 250 (emphasis omitted). Patent Owner amended the claims of the ’195 patent application to recite “maintain[ing] a single static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.” *Id.* at 286 (emphasis omitted).

concentration is enough to teach aiding carrier movement in a particular direction. We observe, in that regard, that the inventor “did not provide the type of detail in” the ’195 patent’s specification that Patent Owner “now argues is necessary in [the] prior art references.” *In re Epstein*, 32 F.3d 1559, 1568 (Fed. Cir. 1994).

We also find Patent Owner’s arguments pointing to a portion of the specification that discloses what it regards as a specific dopant concentration unavailing. PO Resp. 14–15 (quoting Ex. 2061, 2:66–3:15 (the ’195 patent specification)). The ’842 patent discloses that

[t]he *relative* doping concentrations of emitter and collector regions varies from 10^{18} to $10^{20}/\text{cm}^3$, whereas the base region is 10^{14} to $10^{16}/\text{cm}^3$ depending on the desired characteristics of the BJT. In graded base p-n-p transistors, the donor dopant concentration may be 10 to 100× at the emitter-base junction, *relative* to the base-collector junction (1×). The gradient can be linear, quasi linear, exponential or complimentary error function. The *relative* slope of the donor concentration throughout the base creates a suitable aiding drift electric field, to help the holes (p-n-p transistor) transverse from emitter to collector.

Ex. 1001, 2:62–3:5 (emphases added). All of the disclosures of doping concentrations are relative. *Id.* Further still, these concentrations are set forth with respect to a bipolar junction transistor (BJT) that is not encompassed by independent claim 1. The background of the ’842 patent discloses that, in BJTs, the graded dopant concentration moves carriers from emitter to collector, that is, *within* the active region. Ex. 1001, 1:43–57, Fig. 1. In contrast, independent claim 1 requires a graded dopant concentration to aid movement of carriers *away* from the active region to the substrate.

Claim 1 does not require aiding the movement of any particular number of carriers, let alone a need to move all the carriers.

In its Sur-Reply, Patent Owner argues that

[t]he Federal Circuit has *never* said that the test for obviousness—for *all* apparatus claims—is whether the prior art is “capable” of performing the claimed limitation. In fact, the Federal Circuit has made it clear that there are “configuration-type *apparatus* claims” and “capability-type *apparatus* claims.” The type of claim does *not* turn on whether the claim is an apparatus or a method claim;” “[r]ather, it ‘depend[s] on the claim language,’ since ‘differences exist between apparatus claims.’”

PO Sur-Reply 11 (quoting *INVT SPE LLC v. Int’l Trade Comm’n*, 46 F.4th 1361, 1371–72 (Fed. Cir. 2022)). According to Patent Owner, “[w]hen, as here, an apparatus claim requires a specific structure to perform a specific limitation, the Petitioner must prove that the cited references ***actually perform*** that limitation.” *Id.* at 12 (citing *INVT*, 46 F.4th at 1371).

Patent Owner further argues that Petitioner, in advancing a different view, “relies on misleading quotes from *INVT*’s predecessor” case, *ParkerVision, Inc. v. Qualcomm Inc.*, 903 F.3d 1354, 1361 (Fed. Cir. 2018), “to dismiss [Patent Owner’s] arguments as ‘unsupported.’” PO Sur-Reply 12 (quoting Pet. Reply 4). Whereas “[t]he claims-at-issue in *ParkerVision* ‘recite[d] ***no structural limitations*** that would preclude a prior art reference that discloses a different structure from performing the claimed function,” in Patent Owner’s view, the claims at issue in this review, by contrast, “are clear that ‘aid[ing] carrier movement’ can only be achieved by a GDC,” that is, a graded dopant concentration.” *Id.* Further, Patent Owner argues, “[t]here is no ‘different structure’ that can ‘perform the claimed function’” at hand. *Id.* Patent Owner concludes, on that basis, “Petitioner erroneously

suggests that the ‘claims are directed to a device capable of aiding carrier movement (as opposed to requiring movement).’” *Id.* at 13.

We agree with Petitioner that independent claim 1 is not a method claim. In *ParkerVision*, the Court held that “apparatus claims cover what a device *is*, not what a device *does*.” *Hewlett-Packard Co. v. Bausch & Lomb Inc.*, 909 F.2d 1464, 1468 (Fed. Cir. 1990)). That is, to effectively challenge claim 1, Petitioner must show that “the reference discloses an apparatus that is reasonably capable of operating so as to meet the claim limitations, *even if it does not meet the claim limitations in all modes of operation*.” *Id.* (emphasis added).

Petitioner must show “at least one graded dopant concentration” in either or both of the first and second active regions that is *capable* of “aid[ing] carrier movement from the first surface to the second surface of the substrate.” We are persuaded Petitioner has done so by showing that Kawagoe discloses a graded dopant concentration with a slope, in a particular direction, in Figures 17 and 23 of Kawagoe, that not only is reasonably capable of moving, **but actually does** move, carriers in the claimed direction. At least for that reason, moreover, Patent Owner’s arguments about the *INVT* decision are unavailing.

Patent Owner contends that “two District Courts have previously agreed with [Patent Owner] that not *all* doping gradients aid carrier movement.” PO Resp. 17. In particular, Patent Owner contends the Western District of Texas “unequivocally stated, ‘a graded concentration . . . that is [not “sufficiently graded”] will not aid in the movement of minority carriers,’” and the Eastern District of Texas “understood that direction alone does not determine whether a gradient aids carrier movement—the

magnitude of the gradient must also be considered.” *Id.* at 17–18 (citing Ex. 2074, 39–40; Ex. 2075, 15).

Before the Western District of Texas, Cirrus Logic, Inc., a petitioner in the related proceedings, asserted that the term “graded dopant concentration” was indefinite, as it was unclear where the boundary between “graded” and “uniform” doping concentrations would be. Ex. 2074, 32. Patent Owner argued in response that the patent provides sufficient guidance as to the meaning of the claim term, with “graded” meaning varying or not “uniform.” *Id.* at 38–39 (“Greenthread contends that Figure 1 in the ’195 Patent depicts the difference between uniform and graded concentrations, namely, that the concentration in the former is the same across a region while in the latter, the concentration has a slope.”). The District Court determined that the term was not indefinite for multiple reasons and that “graded” “describes a sloped doping concentration.” *Id.* at 39–41. According to the Court, a graded dopant concentration must be sufficiently graded to result in a “static unidirectional electric drift field to aid the movement of minority carriers,” as recited in claim 1 of U.S. Patent No. 8,421,195. *Id.* at 39–40.

We discern no finding in the Court’s order that one must quantify the magnitude of the field in order to know if the electric field will “aid the movement of minority carriers.” First, the Court was not addressing the same argument raised by Patent Owner in this proceeding. Rather, it was addressing whether the term “graded dopant concentration” is indefinite.

Second, the Court’s Order can reasonably be interpreted to require only that the graded dopant concentration be sufficiently graded to create a “static unidirectional electric drift field,” as recited in the claims, which, as

the Applicant argued during prosecution and in its claim construction brief before the Western District of Texas, would “aid in the movement of minority carriers.” Ex. 2074, 39–40; Ex. 1030, 26 (“a [person of ordinary skill in the art] would have readily recognized that when a ‘static unidirectional electric drift field’ is present that it aids the movement of minority carriers. If it isn’t present, then it doesn’t.”), 28 (“The intrinsic record consistently confirms that the electric fields aid the movement of the carriers.”).

Before the Eastern District of Texas, the parties disputed the proper construction of the term “single drift layer . . . having a graded concentration of dopants generating a first static unidirectional drift field.” Ex. 2075, 10. The plaintiff asserted that no construction was necessary, whereas the defendant argued that the term should be construed as a “single layer whose concentration of dopants either increases across the layer or decreases across the layer.” *Id.* The Court explained that the dispute distilled into two issues: (1) whether the graded concentration of dopants could only increase or decrease; and (2) whether the “single drift layer” is necessarily a single layer. *Id.* at 13–14.

In addressing the question of whether the graded concentration of dopants could both increase and decrease in the drift layer, the Court rejected the defendant’s suggestion that the prosecution statement that the direction of the electrical field and the carrier movement “depends solely on the slope of the graded concentration of dopant” demonstrates that “the slope must be only increasing or only decreasing to maintain a unidirectional drift field.” *Id.* at 15. In rejecting this argument, the Court found that the patentee affirmatively argued during prosecution “that a graded dopant concentration

will provide a unidirectional electric drift field to move the minority carriers in a single direction and *Grove*,” relied upon by the Applicant during prosecution, “discloses a dopant concentration that both increases and decreases in the drift layer.” *Id.* at 15–16. Contrary to Patent Owner’s arguments, the Court’s conclusion regarding the scope of the claims appears consistent with both the Applicant’s assertion during prosecution and Petitioner’s arguments in this proceeding, i.e., that “a graded dopant concentration will provide a unidirectional electric drift field to move the minority carriers in a single direction.” *Id.* at 16.

Patent Owner’s litigation position is more on point: “Electric drift fields are a well-known phenomenon that cause carriers to move, and a POSITA would have readily recognized that when a ‘static unidirectional electric drift field’ is present that it aids the movement of the minority carriers. If it isn’t present, then it doesn’t.” Ex. 1030, 26 (Patent Owner’s Responsive Claim Construction Brief in related litigation). Patent Owner’s litigation position is also that “[t]he drift field points to one direction and charge carriers, when free to move, respond to the drift field by moving in *one direction or the other depending on their charge polarity*.” *Id.* at 27 (emphasis added) (citation omitted). More particularly, Patent Owner contends in related litigation that

Defendants argue that the claims do not recite a range of doping, a particular doping profile, or a particular result. But this is not the test for indefiniteness. While the claims require that the graded dopants create an electric field that aids movement of the carriers, *they do not require a specific range of doping, a particular doping field, or a particular result, and this information is not necessary to understand the scope of Dr. Rao’s invention.*

Id. at 28 (emphasis added). Patent Owner’s arguments in this proceeding are unavailing and are inconsistent with positions taken in related litigation.

Analysis Concerning Accounting for Additional Forces

Patent Owner contends that “Dr. Campbell specifically identified” additional forces, including “temperature, capacitance effects at the PN junction, and imperfections in the silicon crystal,” that determine carrier movement. PO Resp. 11 (citing Ex. 2085, 34:15–36:19, 39:8–12).¹⁵ Patent Owner further argues that its own witness, Dr. Glew, identified “the inherent resistance of silicon” as another force that “affects carrier movement,” representing “another factor Dr. Campbell fails to address.” *Id.* at 14 (citing Ex. 2057 ¶¶ 54, 56).

Petitioner counters that, although Dr. Campbell recognized during cross-examination “that other factors theoretically could have influence on carrier movement,” that testimony does not undercut his well-supported opinion that “an electric field oriented downward will push minority carriers away from the surface.” Reply 13 (citing Ex. 1003 ¶ 32). Dr. Campbell explains, and we agree, that “an electric field must have a direction and have a magnitude to influence a carrier (*e.g.*, an electron.)” *Id.* (citing Ex. 2058, 34:1–14). “This is basic physics: an electron needs force applied upon it to drift and the stronger the electric field, the stronger the force.” *Id.* (citing

¹⁵ The cited portions of Dr. Campbell’s testimony do not refer to these forces and it is unclear whether or why the cited testimony supports Patent Owner’s contention. *See* Ex. 2085, 34:15–36:19, 39:8–12 (relating to Dr. Campbell’s agreement or disagreement with statements in a patent owner’s response filed in IPR2023-00468 (“IPR468”)). We observe, however, that Dr. Campbell’s cross-examination testimony in IPR468 appears to relate to Patent Owner’s contention. *See* Ex. 2058, 34:15–36:19, 39:8–12.

Ex. 1054 ¶¶ 4, 5). Indeed, even Patent Owner’s own witness, Dr. Glew, acknowledges “that a graded dopant concentration will create a drift field to aid carrier movement.” *Id.* (citing Ex. 2057 ¶ 33).

We find persuasive, moreover, Petitioner’s argument and evidence that none of the “other supposed ‘forces’” identified by Patent Owner, in fact, “counteract the dopant gradient’s drift field.” *Id.* at 14. Resistance and temperature “are not forces at all,” but are “physical properties that increase or decrease the speed of carrier movement equally in all directions.” *Id.* (citing Ex. 1055, 71:11–23, 79:15–81:5). Furthermore, “crystalline imperfections would not generate a field in a singular direction because they typically would be uniform or minimal and non-impactful.” *Id.* (citing Ex. 1055, 86:7–89:21). That “leaves the force introduced by the P-N junction capacitance as the only factor that—theoretically—could affect the direction of carrier movement.” *Id.*

But “P-N junction capacitance,” of course, “exists in every P-N junction, including those junctions disclosed in the” challenged patent. *Id.* (citing Ex. 1001, Fig. 5(b)). Yet, as Petitioner aptly points out, neither the ’842 patent nor its prosecution history refer to any impact of such capacitance on the drift field created by the dopant gradient, much less indicate that one must account for its counteraction on the drift field created by the dopant gradient. *Id.* at 14–15.

Stated somewhat differently, even if we accept that “the force introduced by the P-N junction capacitance” theoretically “could affect the direction of carrier movement” (*see* Ex. 2058, 35:10–17), we agree with Petitioner that “the ’842 Patent and prosecution history of it says ***nothing*** about such capacitance, much less (1) attributes any significance to it, (2)

suggests that it might counteract the drift field created by the dopant gradient, or (3) claims the capacitance as a problematic force” (Pet. Reply 14–15; *see generally* Ex. 1001). In essence, Patent Owner asks the Board to hold the prior art (and Dr. Campbell’s opinions about the prior art) to a higher standard of disclosure than is provided in the challenged patent. *See In re Epstein*, 32 F.3d at 1568 (“appellant did not provide the type of detail in his specification that he now argues is necessary in prior art references”). The prior art (and Dr. Campbell’s testimony about it) provides the type of detail commensurate with the specification of the ’842 patent.

Taking account of the arguments and evidence advanced by both parties, we agree with Petitioner that the claims “merely require that the claimed ‘graded dopant concentration’ ‘aid carrier movement’—*not* that it generate a field to overcome all other theoretical forces” and find it particularly relevant that none of these theoretical forces “are identified [in] the specification, prosecution history, or the cited prior art.” Pet. Reply 4.

We further agree that “the field effect from the P-N junctions requires an applied voltage for electrons to flow, which the claims do not require,” while “[t]he graded dopant concentration is *static*—always present regardless of the device’s power state.” Pet. Reply 15 (citing Ex. 2058, 35:10–17; Ex. 1059, 18–20);¹⁶ Ex. 1002, 128 (“the claimed invention relates

¹⁶ Patent Owner seeks to exclude Exhibit 1059 because it bears no date and includes “two seemingly disjointed references,” namely, a “textbook excerpt” and “a slideshow presentation.” Paper 57 at 2. Petitioner here cites Exhibit 1059 for a basic technological concept of semiconductor physics that is not disputed adequately, if at all, by Patent Owner. We need not and, therefore, do not rely on Exhibit 1059. Even if we set aside Exhibit 1059,

to . . . devices which include graded dopant concentrations in regions capable of providing a localized drift electric field without the application of an external potential”), 289–290. We further agree with Petitioner that Patent Owner’s own cited evidence (*see* PO Resp. 12 (citing Ex. 2030)) “recognizes that a graded dopant profile—even with capacitive effects—provides an electric field” (Pet. Reply 15 (citing Ex. 2030 7:4–7)).

In summary, the only force that could possibly affect the direction of carrier movement, P-N junction capacitance, is present only when a voltage is applied to the claimed semiconductor device. Even assuming, *arguendo*, that the specification provided any hint or suggestion that P-N junction capacitance must be accounted for, which it does not, claim 1 encompasses

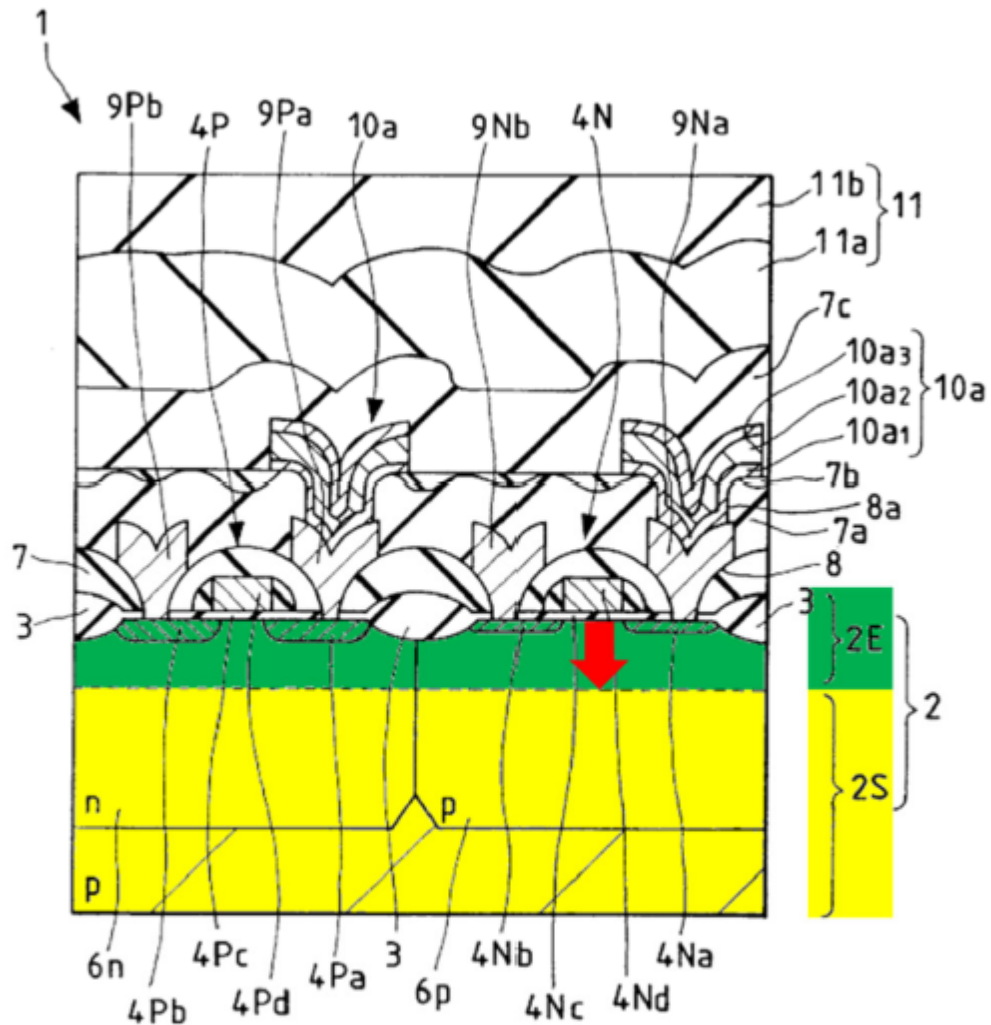
Petitioner makes out adequately the asserted technological concept. Pet. Reply 15 (citing Ex. 1002, 128 (prosecution history); Ex. 2058, 35:10–17) (cross-examination testimony of Dr. Campbell, Patent Owner’s witness)). Alternatively, we take administrative notice that the concept would have been known in the field of semiconductors at the time of the invention, as evidenced by Patent Owner’s own clear assertions to the Office. Ex. 1002, 128 (Patent Owner’s assertions, during prosecution, that “the claimed invention relates to . . . devices which include graded dopant concentrations in regions capable of providing a localized drift electric field without the application of an external potential”); *see* Pet. 9 (“At the time of the invention, Patent Owner represented that it was well-known that a graded dopant concentration creates a static unidirectional electric drift field.”) (citing Ex. 1003 ¶¶ 46–58) (declaration testimony of Dr. Campbell, Patent Owner’s own witness), 9–10 (Patent Owner, arguing during prosecution, that a “graded dopant concentration itself creates a ‘built-in’ electrical field that forces the movement of carriers into a particular direction,” which “depends solely on the slope of the graded concentration of dopant.”) (quoting Ex. 1002, 289–290) (prosecution history, underlining in original)).

situations in which no voltage is applied and P-N junction capacitance does not affect the drift field generated by claimed graded dopant concentration.

Analysis Concerning Kawagoe's Teachings

As to the parties' arguments concerning whether Kawagoe discloses aiding or inhibiting the movement of carriers, we find that, as Petitioner persuasively points out, Patent Owner's "argument that Kawagoe solely '*inhibits* carrier movement' contradicts its literal text." Pet. Reply 16 (citing PO Resp. 16). In that regard, Kawagoe contains express and unambiguous "teachings that 'electrons produced by the α -ray are *attracted* to the substrate body 2S,'" and "Dr. Glew conced[ed] that the gradient imparts a force." *Id.* at 17 (citing Ex. 1007, 16:7–9; Ex. 1055, 122:1–123:7). We agree with Petitioner that Patent Owner quite "illogically suggests" that "everything following the 'and' in 16:7–11 ('prevented') negates everything preceding it ('attracted')." *Id.* at 16–17 (quoting Ex. 1007, 16:7–9; citing Ex. 1055, 122:1–123:70).

Pointing to its annotated version of Kawagoe's Figure 16 (which, for convenience, we again reproduce below), Petitioner persuasively counterargues that "electrons will be attracted to the substrate body 2S (yellow) which means that they exist outside the substrate body 2S (*i.e.*, epitaxial layer 2E (green)) to be attracted to it (red arrow)." *Id.* at 15–16. Petitioner's annotated version of Kawagoe's Figure 16 depicts the direction of electron movement. *Id.* at 16. According to Petitioner, "Kawagoe, moreover, states that its objective is to reduce the influence of α -rays by including a graded dopant concentration 'from the surface of the epitaxial layer 2E, so that the influence to be caused by the carriers (or electrons) due to the α -ray is lowered.'" *Id.* (citing Ex. 1007, 16:2–7; Ex. 1054 ¶ 12).



Petitioner’s annotated version of Kawagoe’s Figure 16 depicts a semiconductor device and, importantly, the direction of electron movement. Pet. Reply 16. In that regard, epitaxial layer 2E (green) is characterized by an “impurity concentration gradually lowered depthwise of said epitaxial layer.” Pet. 12 (quoting Ex. 1007, Abstract). As a result, “the influence to be caused by the carriers (or electrons) due to the α -ray is lowered” such that “the electrons produced by the α -ray are attracted to the substrate body 2S by that concentration gradient.” *Id.* (quoting Ex. 1007, 16:3–8).

Against that backdrop, we find Petitioner persuasively demonstrates that “Kawagoe contains literal teachings that ‘electrons produced by the α -ray are *attracted* to the substrate body 2S.’” Pet. Reply 17 (citing Ex. 1007, 16:7–9). That finding is consistent with the testimony of Patent Owner’s own witness, Dr. Glew, who conceded “that the gradient imparts a force.” *Id.* (citing Ex. 1055, 122:1–123:7).

In that regard, as Patent Owner itself observes, Dr. Glew further explained that “[t]his is an effect in isolation.” PO Sur-Reply 16 quoting Ex. 1055, 123:3-7). Patent Owner’s position that countervailing or counterbalancing fields in the semiconductor device must be computed in order to determine whether actual carrier movement occurs in Kawagoe is not pertinent to our analysis in view of our determination that one of ordinary skill in the art need not know whether there are other forces and fields in an electronic device, as the mere presence of a graded dopant concentration, creating a unidirectional drift field, facing in the appropriate direction, will “aid carrier movement from the first surface to the second surface of the substrate” as claimed. Ex. 1001, 4:59–60 (claim 1).

The evidence presented by Petitioner, therefore, “is enough to render obvious ‘aid the movement’” as specified in claim 1. Pet. Reply 17.

6. *Conclusion Regarding Independent Claim 1*

In view of the foregoing and notwithstanding Patent Owner’s asserted objective indicia of nonobviousness discussed above, we are persuaded that Petitioner establishes, by a preponderance of the evidence, that claim 1 is unpatentable as obvious over Kawagoe.

7. *Independent Claim 9*

Petitioner relies on substantially the same cited teachings in Kawagoe as applied to claim 1 for teaching the limitations of independent claim 9. Pet. 34–35. Patent Owner does not present specific arguments for independent claim 9 beyond what is presented for independent claim 1.

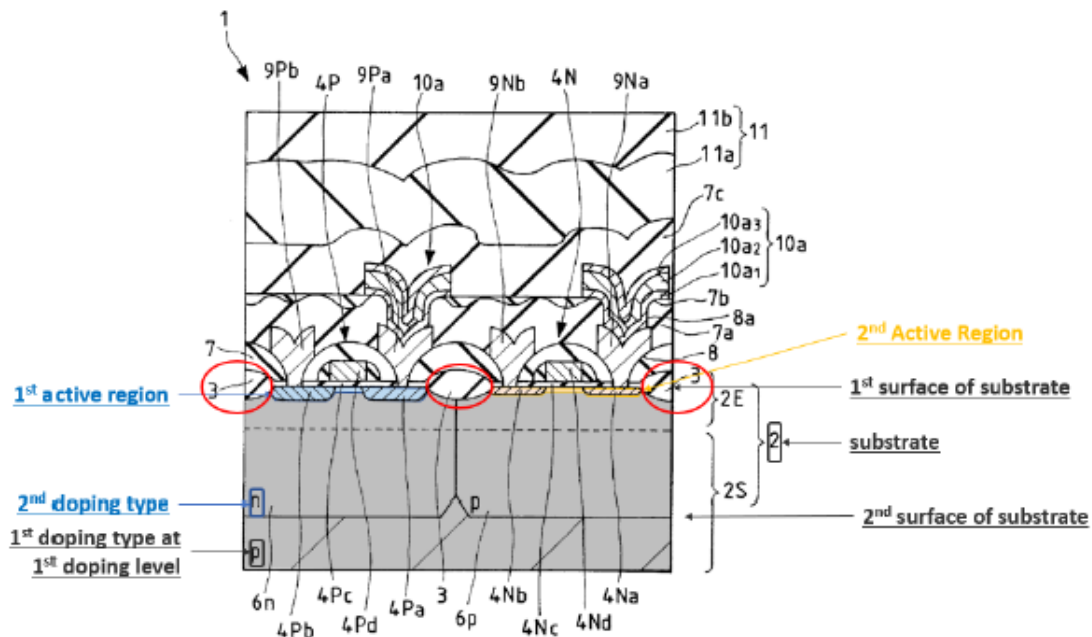
In view of the above, and taking account in particular of Patent Owner’s asserted objective indicia of nonobviousness as discussed above, we determine that Petitioner establishes, by a preponderance of the evidence, that independent claim 9 is unpatentable as obvious over Kawagoe.

8. *Dependent Claims 7 and 15*

Claims 7 and 15 recite “wherein the first active region and second active region are each separated by at least one isolation region.” Patent Owner presents arguments for this limitation.¹⁷ PO Resp. 30–32. In particular, Petitioner maps Kawagoe’s field insulating film 3, annotated as surrounded by red ovals in Kawagoe’s Figure 16, as reproduced below, to the claimed “isolation region.”

¹⁷ In Patent Owner’s Response, Patent Owner points to claims 6 and 27, while referencing claim language recited in claims 7 and 15. See PO Resp. 30–32.

FIG. 16



Petitioner’s annotated version of Kawagoe’s Figure 16 depicting field insulating film. Pet. 31.

Patent Owner argues that “the Petition fails to appreciate that regions 4Na and 4Nb, which ‘are regions for forming the source-drain regions of the nMOS 4N’ ‘are made as deep as about 0.5 μm and ***formed in the range of the thickness of the epitaxial layer 2E.***” PO Resp. 31 (quoting Ex. 1007, 8:66–67, 9:3–6). According to Patent Owner, “Kawagoe provides similar disclosure regarding regions 4Pa and 4Pb” and “a POSITA would have understood that the first and second active regions extend to about the depth of the epitaxial layer 2E and abut each other laterally, and therefore they are not separated by Kawagoe’s field insulating film 3, as required by claims 6 and [15].” *Id.* at 31–32 (citing Ex. 1007, 9:47–53). Patent Owner contends that “[t]he field insulating film 3 is formed ‘[o]ver the principal surface of the epitaxial layer 2E’ (Ex. 1007, 8:40–42) and a POSITA would have

understood that it does not extend deep enough to separate the two active regions.” *Id.* at 32 (second alteration by Patent Owner) (Ex. 1007, 8:40–42).

Petitioner responds that Patent Owner’s “argument wrongly presupposes that the isolation region must separate the two active regions *along their whole depth*.” Pet. Reply 17 (emphasis added). “The claims do not specify the extent of separation of the isolation region; they merely require” that a “first active region and” a “second action region are each separated by at least one isolation region.” *Id.* at 17–18 (quoting Ex. 1001, claims 7 and 15).

Petitioner’s position is firmly grounded in the intrinsic record. *See id.* We conclude that Petitioner has the better position on this issue, for the simple reason that the claims do not require the “isolation region” to completely separate the active regions; that is, that the isolation region extends to a depth that is the same as or deeper than the depth of the active regions. The claimed “isolation region” is not defined or set forth in the specification, only in the claims. *See id.* We further agree with Petitioner that, even assuming, *arguendo*, that the claimed “isolation region” could be interpreted to require *complete* separation, Kawagoe discloses such a configuration wherein “a channel stopper region is formed below the field insulating film 3’ that stops carriers from migrating between transistors, demonstrating that the red-annotated portions [in Petitioner’s annotated Figure 16] are an isolation region.” *Id.* at 18 (quoting Ex. 1007, 8:43–45)).

Notwithstanding Patent Owner’s asserted objective indicia of nonobviousness discussed above, therefore, we determine that Petitioner establishes the obviousness of the subject matter of claims 7 and 15 over Kawagoe by a preponderance of the evidence.

9. *Remaining Dependent Claims 2, 4–6, 8, 12–14, and 16–18*

We have reviewed Petitioner’s arguments and evidence for remaining claims 2, 4–6, 8, 12–14, and 16–18. Pet. 27–30, 31–34, 35–36. Petitioner explains how Kawagoe teaches or suggests the subject matter recited in these claims.

Petitioner’s arguments are fully supported by credible evidence. *See id.* (including evidence cited therein). Patent Owner does not specifically address Petitioner’s arguments and evidence set forth for these dependent claims beyond that which is presented for independent claims 1 and 9. *See generally* PO Resp. Accordingly, we adopt Petitioner’s reasoning as our own. *See* Pet. 27–30, 31–34, 35–36 (and evidence cited therein).

Notwithstanding Patent Owner’s asserted objective indicia of nonobviousness discussed above, and based on the evidence and arguments of record for these claims, as well as for the reasons discussed above regarding independent claim 1, we determine that Petitioner demonstrates by a preponderance of the evidence that the cited portions of Kawagoe teach or suggest what Petitioner asserts they teach—the subject matter recited in dependent claims 2, 4–6, 8, 12–14, and 16–18—and that Dr. Campbell’s testimony sufficiently supports Petitioner’s arguments. *See id.*

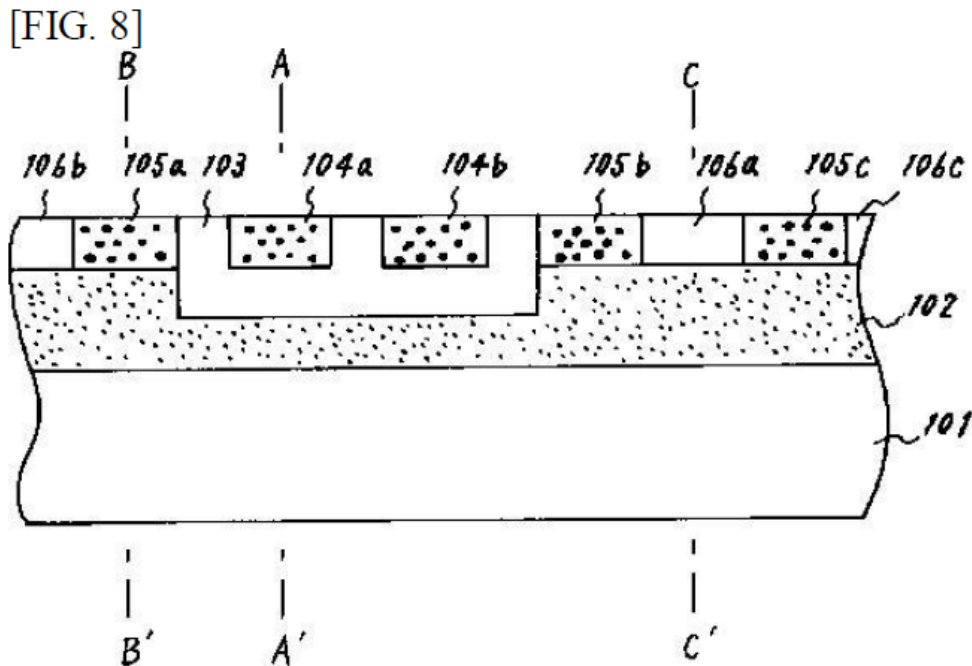
F. *Obviousness Based on Onoda*

Petitioner also contends that claims 1, 2, 4–9, and 12–18 would have been obvious in view of Onoda. Pet. 5, 36–68.

1. *Onoda*

Onoda is titled “Semiconductor Integrated Circuit Device, Nonvolatile Semiconductor Storage Device, and Manufacturing Method” and describes “a nonvolatile semiconductor storage device with improved latch-up

resistance and punch-through breakdown voltage and improved junction breakdown voltage between the well regions and the semiconductor substrate.” Ex. 1042, codes (54), (57). Onoda “relates to a semiconductor integrated circuit device, to a nonvolatile semiconductor storage device, and to methods of manufacturing thereof, and, in particular, relates to a nonvolatile semiconductor storage device wherein a triple-well structure is formed in an epitaxial substrate.” *Id.* ¶ 1. Figure 8 of Onoda, reproduced below, “is a cross-sectional drawing illustrating, in step order [in conjunction with Figures 4–7], manufacturing of a semiconductor substrate 100 to which the first embodiment according to the present invention is applied.” *Id.* at 28 (Brief Descriptions of the Drawings, following paragraph 150 in Onoda’s disclosure).



Onoda’s Figure 8, in conjunction with Figures 4–7, depicts a method for manufacturing a flash memory structured as shown. *Id.* ¶ 46. Figure 8 depicts first semiconductor layer 101, which comprises a heavily-doped P-

type silicon substrate (silicon wafer) with a dopant concentration of $1 \times 10^{19}/\text{cm}^3$ (*id.*) and lightly-doped P-type second semiconductor layer 102 wherein epitaxial layer 102a, as a whole, is between 1×10^{16} and $1 \times 10^{18}/\text{cm}^3$ (*id.* ¶ 47). Figure 8 also depicts N-type first well region 103 with a depth of about $3 \mu\text{m}$ and a dopant concentration of between 1×10^{15} and $1 \times 10^{18}/\text{cm}^3$. *Id.* ¶ 48. Also shown in Figure 8 are boron implantation layers 104A, 104B, 105A, 105B, and 105C, and phosphorus implantation layers 106A through 106C. *Id.* ¶ 49.

2. *Petitioner's Contentions for Independent Claim 1*

Petitioner argues that Onoda would have taught or suggested the limitations of claim 1. Pet. 38–57.

Preamble: “[a] semiconductor device, comprising”

Petitioner contends that Onoda discloses “a nonvolatile semiconductor storage device with improved latch-up resistance and punch-through breakdown voltage.” Pet. 38 (citing Ex. 1042, code (57), ¶¶ 6, 8–11). According to Petitioner, “Onoda’s semiconductor device discloses PMOS and NMOS transistors and fabrication methods.” *Id.* (citing Ex. 1042, claims 1, 7, and 8–12, ¶¶ 6, 7, 12–17); *see id.* (citing Ex. 1003 ¶ 70); *see supra* 46–47 (declining to determine whether preamble is limiting).

Patent Owner does not contest Petitioner’s evidence pertaining to the preamble of claim 1. Based on the complete record developed during trial, we determine that Petitioner demonstrates by a preponderance of evidence that Onoda teaches the subject matter of the preamble of claim 1. As such, we need not and do not determine whether the preamble of claim 1 is limiting.

[1.1] “a substrate of a first doping type at a first doping level having first and second surfaces”

Pointing to its annotated version of Onoda’s Figure 3, Petitioner contends that “Onoda teaches a substrate that has a first and second surface” and that “Onoda’s ‘semiconductor substrate 100’ includes a first and second semiconductor layers 101/102.” Pet. 39 (citing Ex. 1003 ¶ 71; Ex. 1042 ¶ 43, Figs. 2, 3). Petitioner further contends that

Onoda’s “semiconductor substrate 100” (Onoda at [0043]) is doped to be p-type, and this satisfies the claimed “a substrate of a first doping type at a first doping level.” Onoda’s “semiconductor substrate 100” is made of “a first semiconductor layer made from a heavily-doped [] P-type silicon substrate” labeled as 101 and a p-type doped second semiconductor layer 102 on the top of the first semiconductor layer 101.

Id. (citing Ex. 1042 ¶¶ 41, 43).

Patent Owner does not contest Petitioner’s evidence pertaining to limitation [1.1]. Based on the complete record developed during trial, we determine that Petitioner establishes by a preponderance of the evidence that the cited portions of Onoda, supported by Dr. Campbell’s testimony, teach this limitation of claim 1.

[1.2] “a first active region disposed adjacent the first surface of the substrate with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed”

Petitioner contends that “[t]he top portion of each n-well region 106a, 106b, 106c have PMOS transistors, and each of those transistors have an active region.” Pet. 41–42 (citing Ex. 1042 ¶¶ 43 (“106a, 106b, and 106c are N-type [] well regions”), 44 (“plurality of P-channel MOS transistors is formed in fourth well regions 106a, 106b, and 106c”)). Petitioner further

contends that “Onoda’s first active region is also where ‘within which transistors can be formed’” and that “[t]he top portion of each n-well (*i.e.*, 106a, 106b, or 106c), which has the claimed ‘first active region,’ also contains a transistor.” *Id.* at 42 (citing Ex. 1042 ¶¶ 41–45). Pointing to an annotated version of Onoda’s Figure 3, Petitioner contends that “a PMOS transistor (with its gate/source/drain annotated in red and a channel region remains annotated in blue) is formed in the first active region.” *Id.* (citing Ex. 1042 ¶¶ 29 (“a floating electrode formed over a channel region that is positioned between the source region and the drain region”), 41–45); *see id.* at 43–44; *see* Ex. 1003 ¶¶ 80–187).

Patent Owner does not contest Petitioner’s evidence pertaining to limitation [1.2]. Based on the complete record developed during trial, we determine that Petitioner establishes by a preponderance of the evidence that the cited portions of Onoda, supported by Dr. Campbell’s testimony, teach this limitation of claim 1.

[1.3] “a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed”

Petitioner contends that “Onoda discloses a second active region formed in p-type wells 105a, 105b, and 105c, one of which is annotated tan below.” Pet. 45 (citing Ex. 1042 ¶¶ 43 (“105a, 105b, and 105c are P-type [] well regions”), 44, Claim 2 (“floating gate electrode formed over the second well region, positioned between the source region and the drain region”)). Pointing to an annotated version of Onoda’s Figure 3, Petitioner contends that “the second active region (tan) is ‘separate from the first active region’ (blue) and is ‘disposed adjacent to the first active region.’” *Id.* at 46.

Petitioner further contends that “the 2nd active region is a part of p-type well 105c and forms an NMOS transistor, while the 1st active region is a part of n-type well 106a and forms a PMOS transistor.” *Id.* (citing Ex. 1042 ¶¶ 29 (“a floating electrode formed over a channel region that is positioned between the source region and the drain region”), 44 (“the plurality of N-channel MOS transistors is formed in the third well regions 105a, 105b, and 105c, and the plurality of P-channel MOS transistors is formed in the fourth well regions 106a, 106b, and 106c”)); *see id.* at 47–48; Ex. 1003 ¶¶ 88–91).

Patent Owner does not contest Petitioner’s evidence pertaining to limitation [1.3]. Based on the complete record developed during trial, we determine that Petitioner establishes by a preponderance of the evidence that the cited portions of Onoda, supported by Dr. Campbell’s testimony, teach this limitation of claim 1.

[1.4] “transistors formed in at least one of the first active region or second active region”

Petitioner points to its showing for limitations [1.2] and [1.3] and contends that “Onoda discloses transistors that are formed in the first active region and the second active region, where the ‘first active region’ contains a P-MOS and the ‘second active region’ contains an N-MOS.” Pet. 48; *see id.* at 49.

Patent Owner does not contest Petitioner’s evidence pertaining to limitation [1.4]. Based on the complete record developed during trial, we determine that Petitioner establishes by a preponderance of the evidence that the cited portions of Onoda, supported by Dr. Campbell’s testimony, teach this limitation of claim 1.

[1.5] “at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first surface to the second surface of the substrate”

Referring to its showing for limitation [1.3], Petitioner contends that Onoda discloses “a second active region is formed within p-well region 105c” and “that the well region has a doping profile that is downward graded and, consequently, the active region would have the same doping profile because it is formed within the well region.” Pet. 49. Petitioner further contends that “Onoda’s FIG. 11 depicts the graded dopant profile across the p-type well regions 105a, 105b, 105c, which constitutes the ‘at least one graded dopant concentration’ of the ‘at least a portion of at least one of the first and second active regions.’” *Id.* Petitioner also contends that “FIG. 11 is a cross sectional slice (B-B) through the device depicted in FIG. 8, which is the same embodiment as FIG. 3.” *Id.* (citing Ex. 1042 ¶¶ 41–45). Petitioner contends that

the dopant concentration decreases as a function of depth through the third well region 105a (p-type) and the second semiconductor layer 102 (p-type). Then, at the point where the slice reaches the semiconductor layer 101, the dopant concentration increases. (*Id.* at [0052]). Moreover, a POSITA would have understood that third well regions 105b and 105c would have the same dopant profile as region 105a, because the composition of all three regions are identical.

Id. at 49–50 (citing Ex. 1042 ¶ 52; Ex. 1003 ¶¶ 98–100); *see id.* at 50–57; Ex. 1003 ¶¶ 94–117).

Patent Owner disputes Petitioner’s evidence pertaining to limitation [1.5]. We resolve the dispute about this limitation in our analysis below.

3. *Patent Owner's Arguments*

Patent Owner contends that, as discussed with respect to the challenge based on Kawagoe, “the existence of a downward-sloping graded-dopant concentration alone is not sufficient to establish the ‘aid the movement of minority carriers’ claim limitation.” PO Resp. 27 (citing PO Resp. §§ VI.A.2, VI.B.1). Patent Owner contends that

Dr. Campbell admitted that only a “properly constructed” “electric field” “will push minority carriers.” Nothing in the Petition explains how Onoda’s field is “properly constructed” or analyzes the numerous factors that Dr. Campbell admits affect carrier movement (e.g. ***temperature, silicon imperfections, resistance, and slope***) . . . [T]here are a number of PN junctions in Onoda that, according to Dr. Campbell, create “substantial electric fields” which he failed to account. Since Dr. Campbell does not identify the net force acting on the carriers, or analyze the factors necessary to identify it, the Petition fails to show that the gradient aids carrier movement.

Id. (citing Ex. 1003 ¶ 33; Ex. 2058, 34:15–36:19; 39:8–12) (emphasis added). According to Patent Owner,

Petitioner and Dr. Campbell did not take into account anything besides the existence of a downward-sloping concentration gradient in concluding that Onoda teaches the “aid carrier movement” limitations. Therefore, the Petition is based on an incorrect premise and fails to carry Petitioner’s burden.

Id. at 28 (citing Pet. 49–57; Ex. 2057 ¶¶ 52–58).

4. *Petitioner's Reply Arguments*

Petitioner contends that “Onoda teaches a graded dopant concentration from the surface layer to the substrate and a POSITA would have found it obvious that the graded dopant concentration would aid in the movement of minority carriers.” Pet. Reply 18 (citing Pet. 49–57). Petitioner

further contends that Patent Owner’s “argument that Petitioner must conduct an all-force-calculation is not supported by the claims, the prosecution history, or the governing law.” *Id.* at 18–19 (citing Pet. Reply §§ II.A, II.B).

5. *Analysis of the Parties’ Arguments*

We have considered the cited evidence, including expert testimony, and the parties’ arguments pertaining to the limitations of claim 1 that are in dispute. For the same reasons set forth above in Section II.E.5, Patent Owner’s arguments are unavailing. *See* PO Sur-Reply 20–24 (relying on arguments that, in essence, rest on the faulty proposition that Onoda’s graded dopant concentration is insufficient to make out “aid carrier movement” in the active region). No particular magnitude or specific numerical value of slope must be shown in order to satisfy the claims. Petitioner persuasively demonstrates that Onoda teaches the relative slope encompassed by the scope of independent claim 1. *See* Pet. 38–57 (and evidence cited therein). Our reasoning above, presented in the context of the ground based on Kawagoe, applies with equal force here.

In that regard, Patent Owner’s arguments about the necessity to assess the effect exerted by numerous other factors on carrier movement (namely, “temperature, silicon imperfections, resistance, *and* slope”) are unavailing. PO Resp. 27 (Board’s emphasis). Patent Owner faults Dr. Campbell for not taking “into account anything besides the existence of a downward-sloping concentration gradient in concluding that Onoda teaches the ‘aid the carrier movement limitations’” (*id.* at 28), but for reasons discussed above in connection with the ground based on Kawagoe, we find Petitioner’s counterinterviews on this point more persuasive.

A preponderance of the evidence supports Petitioner’s counterview, moreover, that “an all-force-calculation is not supported by the claims, the prosecution history, or the governing law.” Pet. Reply 18–19; *see* Pet. 7–12, 49–57 (Petitioner’s well-supported arguments, including evidence that Onoda teaches a graded dopant concentration that would aid in the movement of minority carriers); *see especially* Pet. 52–53; Ex. 1003 ¶¶ 47, 103 (identifying Patent Owner’s plainly contradictory affirmations to the Office during patent prosecution, where Patent Owner admitted “the graded-dopant concentration *itself* creates a ‘built-in’ electrical field” that “forces the movement of carriers” and, moreover, that “the resulting direction of the carrier movement depends *solely* on the slope of the graded concentration of dopant”) (Board’s emphasis).

Stated somewhat differently, the ’842 patent and its prosecution history focus “solely” on slope (Pet. 9–10, quoting Ex. 1002, 289–290), without taking account of “temperature, silicon imperfections,” or “resistance” as forces affecting carrier movement, on this record (PO Resp. 27). Here again, we decline to hold the disclosure of Onoda (and Dr. Campbell’s testimony about that disclosure) to a higher standard than the disclosure of the challenged patent. *See In re Epstein*, 32 F.3d at 1568 (“[T]he Board’s observation that appellant did not provide the type of detail in his specification that he now argues is necessary in prior art references supports the Board’s finding that one skilled in the art would have known how to implement the features of the references.”).

6. *Conclusion Regarding Independent Claim 1*

For the above reasons, and notwithstanding Patent Owner’s asserted objective indicia of nonobviousness discussed above, we determine that

Petitioner establishes, by a preponderance of the evidence, that claim 1 is unpatentable as obvious over Onoda.

7. *Independent Claim 9*

Petitioner relies on substantially the same cited teachings in Onoda as applied to claim 1 for teaching the limitations of independent claim 9. Pet. 67–68. Patent Owner does not present specific arguments for independent claim 9 beyond what is presented for independent claim 1. In view of the above analysis, and notwithstanding Patent Owner’s asserted objective indicia of nonobviousness discussed above, we determine that Petitioner establishes, by a preponderance of the evidence, that independent claim 9 is unpatentable as obvious over Onoda.

8. *Dependent Claims 2, 4–8, and 12–18*

Petitioner also presents persuasive arguments and evidence that the subject matter of dependent claims 2, 4–8, and 12–18 would have been obvious over Onoda. *See* Pet. 57–67, 68. Petitioner explains how Onoda teaches or suggests the subject matter recited in these claims. *See id.* Patent Owner does not specifically address Petitioner’s arguments and evidence set forth for these dependent claims beyond that which is presented for independent claims 1 and 9. *See generally* PO Resp.

Based on Petitioner’s evidence and arguments of record for these claims, as well as for the reasons discussed above regarding independent claim 1, and notwithstanding Patent Owner’s asserted objective indicia of nonobviousness discussed above, we determine that Petitioner demonstrates by a preponderance of the evidence that the cited portions of Onoda teach or suggest what Petitioner asserts they teach—the subject matter recited in

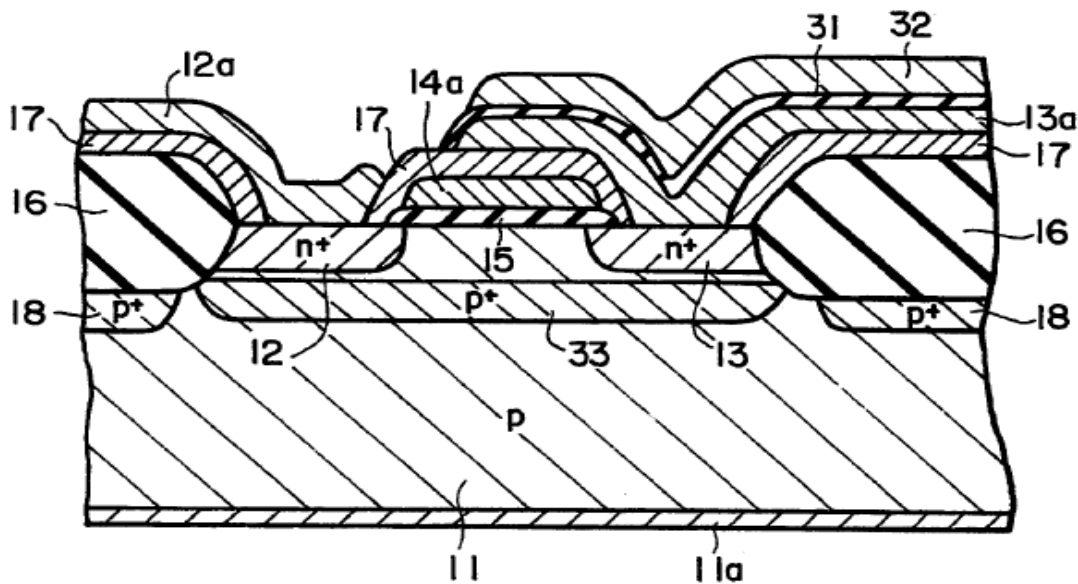
dependent claims 2, 4–8, and 12–18—and that Dr. Campbell’s testimony sufficiently supports Petitioner’s arguments. *See* Pet. 57–67, 68.

G. Obviousness Based on the Combination of Onoda and Nishizawa

Petitioner also contends that claims 1, 2, 4–9, and 12–18 would have been obvious in view of the combination of Onoda and Nishizawa. Pet. 5, 69–76.

1. Nishizawa

Nishizawa “relates to a semiconductor device, and more particularly to a semiconductor device such as an insulation-gate transistor which allows a high packing density integration and effects a good holding of memory contents and which does not make soft errors induced by alpha-particle irradiation.” Ex. 1046, 1:21–29. Figure 16 of Nishizawa, reproduced below, is a diagrammatic sectional view showing the structures of a dynamic random access memory (“d-RAM”) cell. *Id.* at 8:25–26.



Nishizawa’s Figure 16 depicts a p-type substrate 11 and a substrate electrode 11a. The cell includes

n⁺ type regions 12, n⁺ type storage region 13, and
p⁺ type buried region 33a. Ex. 1046, 17:40–47.

Numerals 12a and 13a represent a source electrode and a drain electrode, respectively, which are made of a metal such as aluminum. *Id.* at 2:7–10. Numeral 15 represents a gate oxide film, 16 a field oxide film, and 17 a PSG film. *Id.* at 2:6–7. Numeral 18 represents a p⁺ type region which serves as a channel-stopper region for inhibiting the tendency of formation of a current channel between the field oxide film 16 and p type substrate 11. *Id.* at 2:10–13. Numeral 14a represents a gate electrode made of p⁺ type polysilicon, 13a an n⁺ type polysilicon, 31 a thin oxide film, and 32 a metal electrode such as aluminum. *Id.* at 10:17–20.

2. *Petitioner’s Contentions for Independent Claim 1*

According to Petitioner, “Onoda and Nishizawa both disclose semiconductor devices and are concerned with minority carriers (electrons) moving into the functioning circuitry.” Pet. 69 (citing Ex. 1003 ¶¶ 134–140).

Reason to Combine Onoda and Nishizawa

Regarding motivation to combine Onoda with Nishizawa, Petitioner argues that “[a] POSITA would have been motivated to apply Nishizawa’s teachings of minority carrier diffusion based on a downward sloping dopant gradient (e.g., Nishizawa at 18:46–67) to Onoda’s teachings of a downward sloping dopant gradient (e.g., Onoda at FIG. 11).” Pet. 71. According to Petitioner,

Both Nishizawa and Onoda disclose similar structures with a graded dopant, and while Onoda generally references known issues related to minority carrier movement (e.g., soft errors and latch-up), Nishizawa makes explicit the concept of using an electric field, deliberately created through a dopant gradient, to move minority carriers to a substrate.

Id. at 71–72 (citing Ex. 1046, 18:10–18). Petitioner asserts that a POSITA “would have been motivated to combine teachings of Nishizawa’s explicit discussion of concepts to the structures described in Onoda as confirmation of Onoda’s teachings” and “would have understood that such combinations of known prior art elements would yield expected results and, moreover, would have found it obvious to try such combinations.” *Id.* at 72 (citing Ex. 1003 ¶ 139).

Preamble and Limitations [1.1]–[1.4]

As for the preamble of claim 1, Petitioner contends that “Nishizawa teaches a semiconductor device” and “discloses both memory and CMOS semiconductor devices.” Pet. 72 (citing Ex. 1046, Abstract, 7:40–63, 15:27–52, FIG. 32). Petitioner relies on its Onoda-based Ground II arguments for the limitations [1.1]–[1.4]. *Id.* at 73 (citing Ex. 1003 ¶ 142).

Patent Owner does not contest Petitioner’s evidence pertaining to these limitations of claim 1. We determine that Petitioner demonstrates by a preponderance of evidence that Onoda in combination with Nishizawa teaches these limitations of claim 1.

[1.5] “at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first surface to the second surface of the substrate”

Petitioner contends that “Onoda discloses multiple active regions whose dopant concentrations have a downward gradient, which a POSITA would have recognized as providing an electric drift field in the active region to aid the movement of minority carriers from the first surface to the

second surface of the substrate (substrate 100).” Pet. 73 (citing Ex. 1003 ¶¶ 66–69, 101 & n.7, 113–116, 143). Petitioner further contends that “Nishizawa makes explicit that the downward gradient aids in the movement of carriers to the substrate.” *Id.* (citing Ex. 1046, 18:47–50, 19:1–19, 18:10–18).

Patent Owner disputes Petitioner’s evidence pertaining to limitation [1.5]. We resolve the dispute about this limitation in our analysis below.

3. *Patent Owner’s Arguments*

With respect to Nishizawa, Patent Owner contends that Nishizawa does not cure the deficiencies of Onoda in Ground II. PO Resp. 28. “First,” Patent Owner contends, “Nishizawa is directed to the same problem as Kawagoe, carriers created by alpha rays moving *up* from the *substrate*.” PO Resp. 28 (citing Ex. 2057 ¶¶ 44–45, 59–60; Ex. 2058, 43:8–20). According to Patent Owner, “Nishizawa expressly says that it was not addressing carriers at the surface of the device, because alpha rays do not create carriers there in large enough quantities to be relevant,” and “Nishizawa says carriers at the surface of the device can be ‘disregarded’ for its purposes.” *Id.* at 29 (citing Ex. 1046, 19:21–34, 20:19–22). Patent Owner argues that “[s]ince Nishizawa is silent on carriers in the surface layer, it does not teach the claim limitation.” *Id.*

Second, Patent Owner contends that “Petitioner cannot simply rely on a gradient in Nishizawa for the same reason it cannot rely on the mere gradient in Onoda.” PO Resp. 29. According to Patent Owner,

[a]s with all the grounds, the Petition does not mention the net force on carriers in Nishizawa or analyze numerous relevant factors that act on carriers in addition to the gradient, (e.g. temperature, silicon imperfections, resistance, and slope). As

with Onoda, there are electric field-creating PN junctions in Nishizawa that are not discussed in the Petition. Without analyzing these other forces, Petitioner has no basis to conclude that a mere gradient alone in Nishizawa would aid carrier movement.

Id. at 29–30 (citing Pet. 74; Ex. 2058, 34:15–36:19, 39:8–12; Ex. 2057 ¶¶ 59–60).

4. *Petitioner’s Reply Arguments*

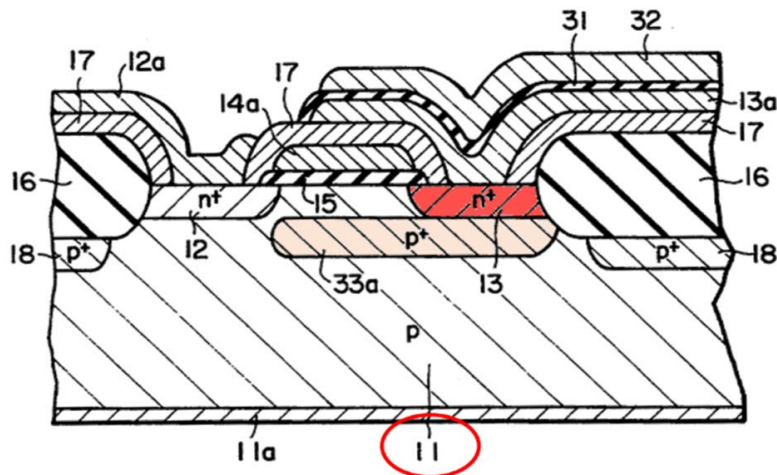
Petitioner argues that Patent Owner “misrepresents Petitioner’s usage of Nishizawa.” Pet. Reply 19. First, Petitioner contends that Patent Owner “misrepresents the Petition as relying on Nishizawa to teach the ‘surface,’ and aiding carrier movement therefrom to the ‘substrate,’” as “Petitioner did not rely on Nishizawa’s device structure.” *Id.* (citing Pet. 73). According to Petitioner, its Ground III “relies on Onoda’s device structure supplemented with Nishizawa’s recognition that a layer with a downward dopant concentration *creates a field that drifts electrons downward.*” *Id.* (citing Pet. 73) (emphasis added).

Second, Petitioner contends that Patent Owner “incorrectly argues that Nishizawa prevents the flow of electrons upwards and does not teach aiding them downward, and that electrons—generated by alpha-rays—at the surface can be ignored.” Pet. Reply 19 (citing Pet. 28–29, IPR2023-01243, Paper 44). According to Petitioner, Patent Owner’s “arguments contradict Nishizawa’s teachings of a graded dopant concentration to drift electrons downward” and Patent Owner’s “arguments that Nishizawa does not create *any* electrons at its surface are wrong.” *Id.* at 19–20. Petitioner takes the position that “Nishizawa teaches that an alpha-ray ‘will not make many’ electrons near the surface, which means that some are created.” *Id.* at 20

(citing Ex. 1046, 17:14–16). FIG. 36 depicts electrons being generated across the alpha-ray's path in the initial 1 μm .” *Id.* (citing Ex. 1046, Fig. 36, 19:67–20:5, 2:45–49 (Petitioner asserting that the reference “stat[es] that the n-type region goes 0.5 μm deep), 19:34–42, 19:56–67; Ex. 1055, 186:12–21 (Petitioner asserting that “Dr. Glew stat[e]s that the claimed ‘surface’ is not size limited)).

With respect to its annotated version of Nishizawa’s Figure 35, reproduced below, Petitioner contends that “Nishizawa teaches that a p⁺ type buried region 33a (tan)—with a substantially uniform dopant concentration—will prevent electrons generated in the p-type substrate 11 (red circle) from entering the p⁺ type buried region 33a.” *Id.* (citing Ex. 1046, 18:4–6, 18:18–22).

FIG. 35



With regard to Petitioner’s annotated version of Nishizawa’s Figure 35, Petitioner argues that “[a] uniform concentration, however, does not solve the problem of electrons generated via alpha-rays in the p⁺ type buried region 33a from reaching the n⁺ type region 13 (red).” *Id.* at 20 (citing

Ex. 1046, 18:35–43). Petitioner further argues that “[t]o solve this problem, Nishizawa teaches ‘it is only necessary to form an impurity concentration gradient in the p+ type buried region 33a in the direction toward the p type substrate 11.’” *Id.* (citing Ex. 1046, 18:46–50; Ex. 1054, 104:5–14 (stating that this layer is creating a force to push electrons downward), 100:2–18 (same); Ex. 1054 ¶ 9).

5. *Analysis of the Parties’ Arguments*

We have considered the cited evidence, including expert testimony, and the parties’ arguments pertaining to the limitations of claim 1 that are in dispute. For the same reasons set forth above in Section II.E.5, Patent Owner’s arguments are unavailing. That is, no particular magnitude or specific numerical value of slope must be shown in order to satisfy the claim. Petitioner sufficiently shows that the combination of Onoda and Nishizawa teaches the relative slope encompassed by the scope of independent claim 1. Our reasoning above, presented in the context of the ground based on Kawagoe, applies with equal force here.

To be clear, we find that “Onoda discloses multiple active regions whose dopant concentrations have a downward gradient, which a POSITA would have recognized as providing an electric drift field in the active region to aid the movement of minority carriers from the first surface to the second surface of the substrate (substrate 100).” Pet. 73 (citing Ex. 1003 ¶¶ 66–69, 101 & n.7, 113–116, 143). We further find that “Nishizawa makes explicit that the downward gradient aids in the movement of carriers to the substrate.” *Id.* (citing Ex. 1046, 18:47–50, 19:1–19, 18:10–18). Petitioner shows persuasively how and why the combined teachings of Onoda and

Nishizawa would have led to the claimed invention. Pet. 69–76;
Pet. Reply 19–21.

Patent Owner, by contrast, focuses on perceived similarities between the disclosures of Nishizawa and Kawagoe (similarities which are unpersuasive to undercut Petitioner’s showing of obviousness, for reasons set forth above in the context of the ground based on Kawagoe) and, where that fails, highlights individual shortcomings in each applied reference (Onoda and Nishizawa) without accounting adequately, if at all, for what the combined disclosures of those applied references fairly would have suggested to an ordinarily skilled artisan. *See* PO Resp. 28–30; PO Sur-Reply 24. One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co., Inc.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

6. *Conclusion Regarding Independent Claim 1*

In view of the foregoing and notwithstanding Patent Owner’s asserted objective indicia of nonobviousness discussed above, we are persuaded that Petitioner establishes, by a preponderance of the evidence, that claim 1 is unpatentable as obvious over the combination of Onoda and Nishizawa.

7. *Independent Claim 9*

Petitioner relies on substantially the same cited teachings in Onoda and Nishizawa as applied to claim 1 for teaching the limitations of independent claim 9. Pet. 75.

Patent Owner does not present specific arguments for independent claim 9 beyond what is presented for independent claim 1. In view of the above and notwithstanding Patent Owner’s asserted objective indicia of

nonobviousness discussed above, we determine that Petitioner establishes, by a preponderance of the evidence, that independent claim 9 is unpatentable as obvious over the combination of Onoda and Nishizawa.

8. *Dependent Claims 2, 4–8, and 12–18*

Petitioner advances similarly persuasive arguments and evidence for dependent claims 2, 4–8, and 12–18. *See* Pet. 75, 76. Petitioner explains, and we agree, that Petitioner’s arguments as to the grounds based on Kawagoe and Onoda apply equally to this ground as presented against claims 2, 4–8, and 12–17. *Id.* at 76. As for claim 18, Petitioner also explains how Nishizawa teaches the specified CMOS. *Id.* at 75 (citing Ex. 1046, 7:61–63, 15:27–52, FIG. 32; Ex. 1003 ¶ 147).

Patent Owner does not specifically address Petitioner’s arguments and evidence of set forth for these dependent claims beyond that which is presented for independent claims 1 and 9. *See generally* PO Resp. On this record, therefore, notwithstanding Patent Owner’s asserted objective indicia of nonobviousness discussed above, and based on the evidence and arguments of record for these claims, as well as for the reasons discussed above regarding independent claim 1, we determine that Petitioner demonstrates by a preponderance of the evidence that the cited portions of Onoda and Nishizawa teach or suggest what Petitioner asserts they teach or suggest—the subject matter recited in dependent claims 2, 4–8, and 12–18—and that Dr. Campbell’s testimony sufficiently supports Petitioner’s arguments.

H. *Constitutionality of AIA*

Patent Owner argues “[t]he Board should dismiss this IPR, because the AIA violates the Supreme Court’s non-delegation doctrine and the

Constitution.” PO Resp. 59. Patent Owner argues the Director improperly has authority to direct whether Patent Owner may receive legal process in the federal courts. *See id.* at 59–60 (“[T]he Director decides whether [Patent Owner] ‘should receive *certain legal processes* (those accompanying Article III proceedings)’ such as the protections of a jury trial and the clear and convincing evidence standard for patent validity.”). Patent Owner also takes issue with “the Director’s unreviewable discretion” to institute proceedings. *See id.* at 60 (“Since Congress provided no intelligible principle for the Director to apply in deciding whether to institute IPR proceedings, the statute governing these proceedings is unconstitutional and the Petition must be dismissed.”).

The Supreme Court has already upheld the constitutionality of IPRs. *Oil States Energy Servs., LLC v. Greene’s Energy Grp., LLC*, 584 U.S. 325, 344–45 (2018). The specific challenge raised by Patent Owner is also logically flawed. Patent Owner’s argument that IPRs are unconstitutional because the Director decides whether Patent Owner “should receive *certain legal process*” (*see* PO Resp. 59–60) is unavailing because these IPRs did not foreclose Patent Owner from litigating its patents in an Article III court. Here, Patent Owner pushed for an Article III court (the District of Delaware) to evaluate the validity of its patents in parallel to these IPRs. *C.f.* EX1060 (PO Opp. to Mot. to Stay). That Article III court simply exercised its own discretion and stayed the case. *See* Prelim. Resp. 23.

As to the challenged “unreviewable discretion” of the Director, we note that the Federal Circuit recently denied petitions for writ of mandamus challenging such discretion. *See, e.g., In re Motorola Sols., Inc.*, 159 F.4th 30, 36 (Fed. Cir. 2025) (“Congress committed institution decisions to the

Director’s discretion” and “protected that exercise of discretion from judicial review by making such determinations ‘final and nonappealable.’” (citing 35 U.S.C. § 314(d); *SAS Inst., Inc. v. Iancu*, 584 U.S. 357, 366 (2018)); *see also United States v. Arthrex, Inc.*, 594 U.S. 1, 8–9 (2021) (“Congress has committed the decision to institute inter partes review to the Director’s unreviewable discretion.”).

III. PATENT OWNER’S MOTION TO EXCLUDE EVIDENCE

Patent Owner moves to exclude Petitioner’s Exhibit 1059, titled “Understanding the *p-n* Junction,” for being “irrelevant and lack[ing] proper authentication.” Mot. Exclude 2. According to Patent Owner, Exhibit 1059 is irrelevant “since there is *zero* evidence on the face of the document to determine whether it was published or publicly accessible before the critical date of the Challenged Patent.” *Id.* Patent Owner further contends that “Petitioner has not offered any evidence sufficient to support a finding that the exhibit (and the pages cited in its Reply) is what Petitioner claims it is under FRE 901.” *Id.* at 4. We decline to strike Exhibit 1059 from the record, as we did not rely on it in any way in reaching our decision. *See supra* n.14. Patent Owner’s Motion to Exclude Evidence is dismissed as moot.

IV. CONCLUSION¹⁸

In summary:

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1, 2, 4–9, 12–18	103(a)	Kawagoe	1, 2, 4–9, 12–18	
1, 2, 4–9, 12–18	103(a)	Onoda	1, 2, 4–9, 12–18	
1, 2, 4–9, 12–18	103(a)	Onoda, Nishizawa	1, 2, 4–9, 12–18	
Overall Outcome			1, 2, 4–9, 12–18	

V. ORDER

It is

ORDERED that Petitioner has established, by a preponderance of evidence, that each of challenged claims 1, 2, 4–9, and 12–18 of the '842 patent is unpatentable as obvious under 35 U.S.C. § 103(a);

FURTHER ORDERED that Patent Owner's Motion to Exclude is dismissed as moot;

¹⁸ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

FURTHER ORDERED that, in view of the motions to seal, this Decision is filed “Board and Parties Only”;

FURTHER ORDERED that, after conferring, the parties shall, within one week of this Decision, jointly submit to the Board via email to Trials@uspto.gov, a version of this Decision to be filed in the public record, with any redactions proposed by either party; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to this proceeding seeking judicial review of this Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

IPR2024-00550
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